



U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Wildlife Services

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A Study and Review of THE BLACK FRANCOLIN AND THE GRAY FRANCOLIN

By

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Special Scientific Report--Wildlife No. 81
Washington, D. C. • April 1964

THE FOREIGN GAME INTRODUCTION PROGRAM

Year by year the number of individuals seeking relaxation through hunting is increasing. Yet the area available for this sport is slowly decreasing. Likewise, much of the habitat which mothers the game crop is becoming less and less able to produce shootable surpluses under the impact of clean farming, over-grazing, drainage, power equipment, increased use of insecticides and herbicides, scientific forestry, urbanization, and declining soil fertility.

Faced with this situation, common sense dictates an all-out effort to increase habitat productivity. But there are many habitats which have been so thoroughly changed by man that native game species can no longer maintain themselves therein in numbers sufficient to provide good hunting. Competing interests and the cost of reversing this trend are such that only a part of these lands can be restored to reasonable productivity in the foreseeable future. There are other coverts which never were fully occupied by native game birds or mammals possessing the characteristics requisite to survival in the face of today's intensive hunting pressure. For these, new, adaptable species possessing a high hunting resistance should be sought, so that such areas might provide greater hunting opportunities. This is the logic behind the foreign game introduction program as developed cooperatively by the U. S. Fish and Wildlife Service, cooperating State Fish and Game Commissions, and the Wildlife Management Institute.

The program is based on requests for assistance from State Fish and Game Commissions following an ecological appraisal of their game-deficient habitats. After such information is in hand, biologists are assigned to make a careful study of game species occupying similar habitats and climates in foreign countries. From dozens considered, one or two may be selected on the basis of their characteristics, habits, reproductive capacity, resistance to predation and disease, relationships to agriculture, ability to withstand heavy hunting pressure, and the possibility of competition with game species native to the United States. Modest, carefully planned trial introductions of these species, utilizing wild-trapped or hand-reared individuals, carefully quarantined before shipment are then carried out in cooperation with interested State Fish and Game Commissions. Unplanned or "hit and miss" introductions are actively discouraged.

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FOREWORD

Much game habitat in southern Asia resembles, in many respects, that found in the southern and southwestern United States. In some regions game birds are abundant. Over 70 species and subspecies are resident in the Indian subcontinent alone. For the past 12 years biologists of the Bureau's Foreign Game Introduction Program have reviewed the literature and made on the spot analyses of the characteristics of most of these birds. Based on the results, 10 species were selected for intensive study. The purpose was to determine whether or not trial introductions into the United States, of one or more of these species, might be justified.

The current report summarizes the results of studies of two species, the black francolin (Francolinus francolinus) and the gray francolin (Francolinus pondicerianus). Attention is directed to two subspecies, the northern black francolin and the northern gray francolin, which appear to be particularly worthy of consideration in detail.

Though the senior author was directly responsible for this study, it was in many respects a team effort. My assistant, Wayne H. Bohl, and photographers of the U. S. Information Service in Pakistan and India, took many of the illustrations. Both Bohl and Glen C. Christensen were active in the field work involved and contributed valuable information. My wife, Janet Bump, reviewed the literature, examined birds trapped in India for evidence of diseases and parasites, handled the hatching of eggs, the rearing of the young chicks and constructed the climacurves and climatic comparisons for this report. Their unfailing support, and that from many others, has made this report possible.

Gardiner Bump

ABSTRACT

This report summarizes the taxonomy and distribution of representatives of the genus Francolinus native to southern Asia and their introduction into other regions. Of these the northern black francolin (Francolinus francolinus asiae) and the northern gray francolin (Francolinus pondicerianus interpositus) are singled out for detailed consideration since trial releases of these two subspecies are currently underway in southern and southwestern United States. Topics covered include descriptions, habitat, climatic requirements, food and water, general habits, effect of predation, reproductive capacity, and diseases and parasites. An analysis of competing interests, including man and game, breeding, rearing and trapping are also considered.

FRANCOLINS IN GENERAL

Francolins are partridge-like birds resident in Asia and Africa. The genus Francolinus to which they belong, is extremely large, consisting of 34 species and 81 subspecies. Closely-allied are the bare-throated francolins or spurfowl (Pternistis) of which 4 species and 19 subspecies, all found in Africa, are recognized. All are classified as game birds, some of which are locally held in very high regard. Rather curiously, they are with few exceptions little known among aviculturists and sportsmen in the New World.

Five species and 12 subspecies of francolins are found in southern Asia. Such speciation suggests that this group might be adapted to many different habitats. Accordingly these birds were rather carefully evaluated by Foreign Game Introduction Program biologists assigned to study the great variety of game birds resident there.

Though francolins are present from Turkey and Israel eastwards, the center of distribution is the Indian sub-continent into which, in the distant past, they possibly extended their range from Africa. Among the British, during their long occupation of India, were a number of keen students of birds. The written observations of such ornithologists as Hume and Baker, provided a welcome background of taxonomic and life history material which aided Program biologists in eliminating all but the black and the gray francolin from consideration as potential candidates for trial introduction into the United States.

The black francolin was originally a grassland species which has adapted itself very successfully to cultivation, particularly about watercourses in areas where the rainfall does not exceed 15 inches per year. It also thrives in a wider variety of habitats under higher precipitation. The gray francolin is more of a semi-barren or range land species which similarly takes to cultivation and stubble fields where the vegetation is not dense or is open beneath.

This report supplements the Game Bird Data Sheets, previously prepared, covering these species. It is based on a comprehensive review of the literature and on field observations of these birds from Turkey to India. Emphasis is placed on points salient to the consideration of each species for trial introduction including the general habitats in various States in which either or both might well be worth a trial.

Taxonomy and Distribution

The francolins, as currently classified, represent a very large, rather heterogeneous assortment of game birds. Peters (37) indicated that the genus Francolinus "could probably be dismembered to advantage" but the only substantial revision suggested to date has been by Roberts (43) who reclassified the species resident in South Africa into five new

genera. Mackworth-Praed and Grant (32) did not accept this revision in reviewing the francolins of East Africa, and it is possible that further changes will be largely concerned with a more exact delineation of the distribution of species and subspecies.

The range of most of the Asian species is extensive. This is true also of some of the African francolins but many of these are rather highly selective of habitat with the consequent development into species and subspecies in considerable variety. Peters lists 29 species and 69 subspecies of African francolin and 5 species and 12 subspecies of this genus in Asia. The latter group, with special reference to the black and the gray francolins and their currently recognized range, as indicated by Peters and modified by Ripley (42) is classified as follows:

Order	Galliformes
Family	Phasianidae
Genus	<u>Francolinus</u>

<u>Species</u>	<u>Common Name</u>	<u>Distribution</u>
<u>F. francolinus</u> <u>francolinus</u>	Western black francolin	Cyprus, Asia Minor, Syria, and Israel east through Iraq and central Iran and north to Transcaucasia and the southern and southeastern Caspian littoral
<u>F. francolinus</u> <u>arabistanicus</u>	Arabian black francolin	Baghdad to the Persian Gulf and to southwestern Iran
<u>F. francolinus</u> <u>bogdanovi</u>	Southern Iranian black francolin	South Iran from Seistan to Iranian Baluchistan
<u>F. francolinus</u> <u>henrici</u>	Baluchistan black francolin	Baluchistan and southern Sind, west of the Indus, in West Pakistan, and probably north to Kandahar and the Helmand Valley of southern Afghanistan and the lower valleys of the Northwest Frontier provinces
<u>F. francolinus</u> <u>asiae</u>	Indian black francolin	Eastern Afghanistan (Jalalabad), through the Indus Valley and tributary streams in West Pakistan eastwards along the foothills of northern India to central Nepal and Bihar, and south to central India. Not in the Thar desert of Rajasthan from Pali to the eastern border of Bahawalpur

<u>Species</u>	<u>Common Name</u>	<u>Distribution</u>
<u>F. francolinus melanonotus</u>	Assam black francolin	Eastern Nepal, through Assam and East Pakistan south to Orissa in India
<u>F. pictus</u> (three subspecies)	Painted francolin	Central and southern India and Ceylon
<u>F. pintadeanus</u> (two subspecies)	Chinese francolin	Manipur east to Indo-China and southern China
<u>F. pondicerianus mecraensis</u>	Makran gray francolin	Eastern Arabia (Muscat), southern Iran and eastern and southern Afghanistan, Baluchistan, the Northwest Frontier, and south almost to the Indus River in southern West Pakistan
<u>F. pondicerianus interpositus</u>	Northern gray francolin	West Pakistan in the Indus Valley and from the Sind or Thar desert east and south of the Himalayas to southern Nepal and south to Bihar, West Bengal, and Central India through Rajasthan and Gujarat to Poona and the Godavari River
<u>F. pondicerianus pondicerianus</u>	Southern gray francolin	South of the range of <u>interpositus</u> in India to northwestern Ceylon
<u>F. gularis</u>	Swamp francolin	Southern Nepal and northern India east to Assam and East Pakistan

Introductions

Unlike the pheasants, few attempts have been recorded to acclimatize francolins to new areas or to raise them in captivity. The southern gray francolin (F. p. pondicerianus) has been successfully introduced into the Andamans, Amerante, Mauritius and Rodriquez Islands. F. pintadeanus, the Chinese francolin, has taken in Madagascar, Mauritius, Reunion, the Andamans and Luzon Islands, though in the Philippines it has never become widely established.

The Erckel's francolin (F. erckelii), from the high plateau country of Ethiopia, has received some attention as a game bird for release on shooting preserves in the western United States but to date, has shown but little reproductive success where liberated.

Although a few of the black and the gray francolins from West Pakistan were released in several southwestern States as early as 1955 it was not until five years later that large numbers of wild-trapped birds became available to States cooperating with the Bureau's Foreign Game Introduction Program. Between 1960 and 1963, 5,155 wild-caught and 716 hand-raised black francolins, predominantly F. f. asiae, were liberated in 12 States, mainly in the Southeast and in Guam. During the same period 5,911 gray francolins (F. p. interpositus), wild trapped in Northern India and 683, hand-raised in Texas, were liberated by State Conservation Commissions mostly in Hawaii, Guam and the Southwest. Francolin introductions carried out by States cooperating with the Bureau's Foreign Game Introduction Program are listed and discussed in Special Scientific Report - Wildlife No. 80 (11). Previous to release, State wildlife biologists were provided with a factual analysis of the habitat types to which the birds were adapted in their native range, thus minimizing the probability of liberation in unsuitable cover.

A period of at least 5 to 10 years is required to evaluate the results of such trial introductions. Current indications suggest that the northern black francolin (F. f. asiae) is doing remarkably well in two areas in Louisiana and is at least holding its own in one area in Florida and in South Carolina. The northern gray francolin (F. p. interpositus) has apparently become established in several parts of Hawaii, and is maintaining its numbers on two areas in Nevada. Both are also reported from Guam. Results of liberations elsewhere are as yet indeterminate, with some failures recorded principally from sections of the country where temperatures commonly fall well below freezing in winter and snow is not uncommon.

THE FRANCOLINS OF SOUTHERN ASIA

This report is primarily concerned with those francolins of southern Asia that occupy habitat whose main characteristics are not unlike those in the United States in which new game birds are desired. Of the five species resident in Asia, three were eliminated from further consideration rather quickly by Program biologists. The swamp francolin (F. gularis) was not particularly abundant even in its wet, tall-grass habitat, the counterparts of which are of limited occurrence in the States. The painted francolin (F. pictus) thrives where temperatures, both winter and summer, are generally warmer than is characteristic even of the Southwest. Since the Chinese francolin (F. pintadeanus) was found mainly east of India, in zones of increasingly heavy precipitation, it was not practical to evaluate its potentialities in detail while working in the Indian subcontinent. Thus attention was concentrated on the black and the gray francolins both of which are abundant, easily trappable over most of their extensive range, and occupy habitat and climatic niches found commonly either in southern or in southwestern United States.

THE BLACK FRANCOLINS

Six subspecies of the black francolin were considered. Four of these, because of limited distribution, inaccessibility, or climatic factors were soon eliminated, leaving only the Middle East francolin (F. f. francolinus) and the Northern Indian francolin (F. f. asiae) for more detailed study. Since each subspecies seemed equally and potentially adaptable to Stateside habitats, representatives of both were trapped for trial but, by one of those chances over which biologists have little control, only F. f. asiae was secured in numbers sufficient to constitute a fair test of species adaptability under American conditions.

Common Names

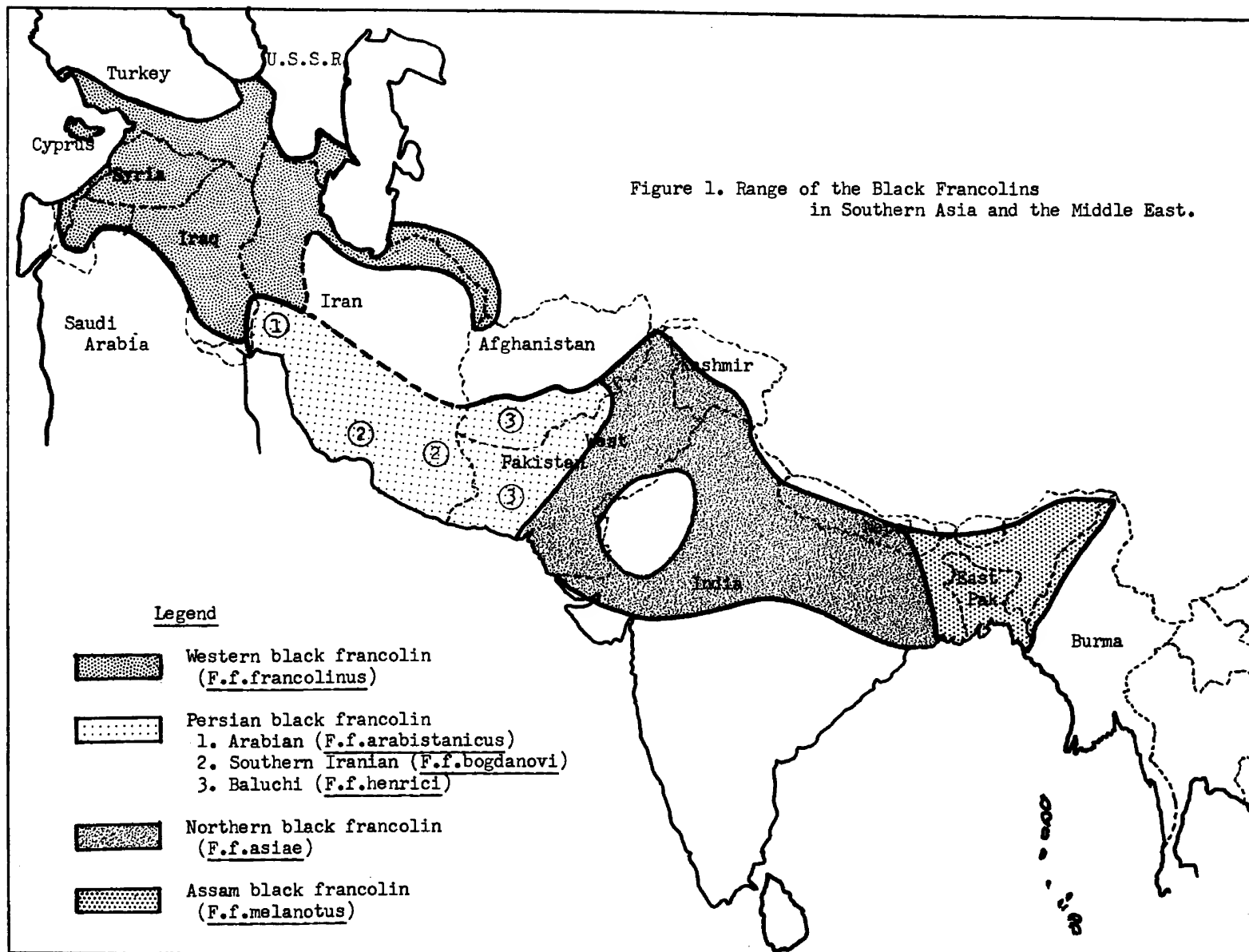
As in many places, common names of birds vary radically by district and dialect. Wherever the British have settled, partridge is the name most commonly given to birds of the genus Francolinus. Because of the certain confusion with other birds termed partridges in the United States, the use of francolin has been encouraged in reference to those species introduced into the United States.

Names most frequently encountered in southern Asia for black francolins include the following:

Black francolin	English
Black partridge	English
Common francolin	General
Kala-titur or	Hindi, Urdu (Pakistan,
Kala-tetri	India)
Tatra Kalo-tetra	Garwal (India)
Urenbi	Manipur (India)
Mechenter	Assam (India)
Tetri-sarai	Assam (India)
Dae-chirree	Cachar (India)
Inrui-jirip	Catcha-Naga (India)
Kais-tetur	Nepalese
Dorraj	Iranian and Arabic
Por	Kurdish
Turac	Turkish
Francolino	Italian
Francolin	German

Distribution and Relative Abundance

Hume and Marshall (26) considered that at one time the black francolins inhabited southern Spain, Sicily, Sardinia, Algiers, Tunis, and many islands of the Greek archipelago; currently they are found only from Cyprus east to Burma, a range which is still some 4,000 miles in length.



The western black francolin (F. f. francolinus) is fairly common in southern Turkey, south of the Taurus Mountains, and through Syria, Israel, and northern Iraq to southwest of Baghdad where it is very abundant. Peters (37) and Dementiev (13) also assign birds resident in Transcaucasia and about the southern half of the Caspian littoral to this subspecies. We found these birds very abundant in grain fields north of the Elbruz Mountains and east of Gurgan in Iran, and Dementiev indicates that they are found also farther north in southern Siberian Turkomen.

The northern black francolin (F. f. asiae), apparently crossing freely with F. f. henrici from southern West Pakistan north to Lahore and Chitral, extends northwestwards over the Khyber pass to Jalalabad in eastern Afghanistan. Babur (1), one of the Mogul emperors, reports black francolin to have been common in (all) Afghanistan about 1500. Another emperor, Jehangir (1) found many of these birds near Bakkar (Sind) in 1620. Progressing eastwards through northern India, specimens more typical of asiae are the rule. Few birds are found east of Bahawalpur or in the Sind or Thar desert area until one reaches Pali, east of Jodhpur. In central Nepal either this subspecies or F. f. melanonotus has extended its range through the Terai into the Central Valley (Ripley 41).

Providing acceptable food, cover, and water are present, altitude plays but little part in the distribution of the black francolins. We have collected them from less than a hundred feet above sea level in Turkey, Iraq and about Karachi, and shot them while hunting for Kalij pheasants on terraced and cultivated hillsides at about 6,000 feet near Simla on the flanks of the Indian Himalayas. Hume reports them up to 7,000 feet in Pakistan, Baluchistan and adjacent Afghanistan and Whistler (54) found them up to 8,500 feet near Simla. Higgins (24) found the Assam black francolin (F. f. melanonotus) in the valleys and hillsides along the Brahmaputra River and along the eastern hills of Manipur up to 6,000 feet. Southeast of the Caspian Sea, they occur from below sea level up to about 3,000 feet in grassy areas interspersed with cultivation. Proud (38) reports these birds to be very common and increasing in numbers on the hills about Kakani, Nepal at 5,000 to 7,000 feet.

In good cover substantial numbers of black francolins may be found. In one fairly narrow band of tamarisk and grass thickets along the Tigris River below Baghdad local beaters put up over 60 birds for us in about two hours. From fields of sugarcane, wheat, mustard, weeds, and grass in India or Pakistan, it was not unusual to flush 30 to 50 black francolins and often a like number of gray francolins in a 4-hour beat. Hume writes of places where he could make sure of bagging 50 brace of blacks in one day. Even so, possibly because of their greater cover selectivity, it is easier to overshoot black than gray francolins.

Description

Field Identification

Black francolins are partridge-like birds, about twice the size of the bobwhite quail, found in crops or tall grasslands and attracting attention by their extraordinary cicada-like call. Both sexes have a peculiar scaled type of coloration on the top and sides of the body. The male is particularly conspicuous for its black underparts, often boldly spotted or streaked with white, prominent white cheeks, and chestnut neck collar.

Key to Subspecies

Stuart Baker (4), who wrote The Game Birds of India, Burma and Ceylon, provided a key to and description of species and subspecies of the black francolin group resident in the Indian subcontinent. The following is adapted from this, supplemented by personal observation:

Quills transversely barred or spotted with buff on both webs - black francolins.

A. Scapulars with conspicuous, buff, submarginal band

a. Males with chestnut collar; females with chestnut nape patch

b. Many large white spots on breast. F. f. francolinus

b' White spots tending to become more like stripes; paler. F. f. henrici, F. f. arabistanicus, F. f. bogdanovi (a)

b'' White spots largely replaced with stripes; darker. F. f. asiae

b''' White spots or stripes much less conspicuous; darkest with much black above and below. F. f. melanonotus

a' No chestnut collar or patch

c. Color generally dark F. p. pictus

c' Color generally pale F. p. pallidus

A' No submarginal buff band on scapulars F. chinensis

(a) Baker unites arabistanicus, bogdanovi and henrici

Coloration of Indian Black Francolin (F. f. asiae)

"Male -- Crown to nape sandy or rufous brown, the feathers centered dark brown, supercilium and feathers around eye black; broad white band from lower lores, cheeks and ear coverts white; chin, throat and broad patch below ear coverts running up to nape, black; feathers of nape showing little black and white mottling. Broad chestnut collar all round neck; behind collar, back and sides black, each feather with a submarginal black-edged band of buff or sandy rufous, the transition from black upper back being very gradual. Lower back, rump, upper tail-coverts and tail feathers with narrow white or fulvous-white bars; outer tail feathers with terminal third unbarred. Below, breast is black, unspotted in very old males in center, but with oval white spots (or streaks) on sides; flanks black with larger, longer oval white spots, sometimes becoming longitudinal bars on the posterior flanks and generally with narrow brown fringes; lower breast and thigh coverts black to blackish brown with very large white spots or bars; center of abdomen and vent light chestnut with whitish bars, under tail-coverts chestnut, rarely having a few bars of white or fulvous. Under wing-coverts and axillaries mottled fulvous and dark brown." We have found that young birds have more white spots on breast and flanks than do older birds.

"Iris, hazel-brown to dark brown. Bill black or dark horny brown, the tip of mandible whitish; legs and feet brown to orange red or brick red, always brighter and redder during breeding season. Claws black or horny brown; spurs blunt, dark horny, often paler at tip.

"Female -- Above similar to male but paler and duller; the black and white cheeks and supercilia replaced by dull pale buff; ear coverts brown or buffy brown and cheeks more or less speckled with brown. The chestnut collar replaced by a duller nuchal patch sometimes freckled or slightly barred with brown. Rump, upper tail-coverts and central tail feathers dull, pale brown with narrow, wavy bars of pale buff edged with black; outer tail feathers as in male.

"Below, chin, throat and foreneck white or buffy white, sometimes with rufescent tinge, with wavy, arrow-shaped bars, narrowest on neck and upper breast, and gradually becoming broader on the posterior flanks and lower breast, and again fewer and narrower on the abdomen where they occasionally disappear altogether. Ventral region pale, dull chestnut, sometimes with faint brown bars and sometimes with whitish tips; under tail-coverts chestnut.

"Soft parts as in male but legs never as red as male in breeding season. The bill is paler, more a horny brown than black and the base and gonyes paler still." Females are usually without or with only rudimentary spurs though one bird from near Delhi possessed a well-developed spur on one leg.

Young males may be recognized by flecks of black on breast and flank feathers at about three months of age.

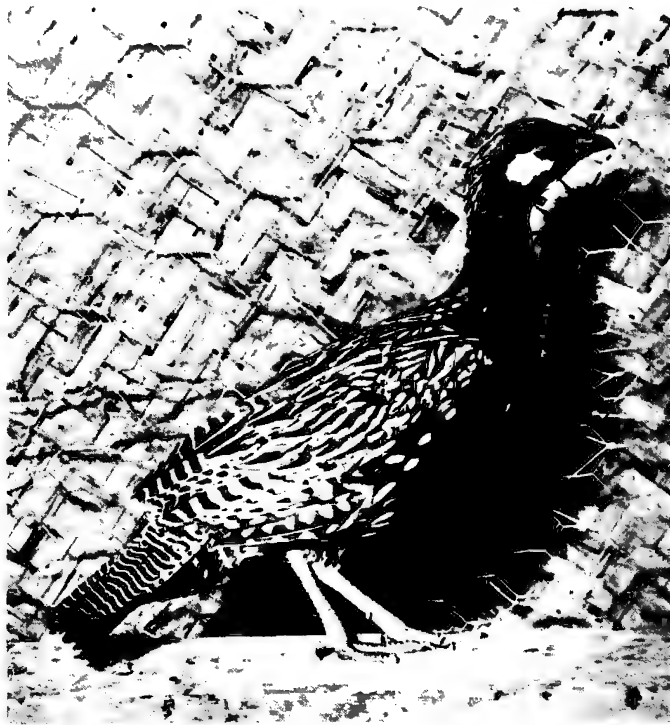


Figure 2. The feather pattern of the male black francolin is distinctive. The metatarsal spurs are blunt.



Figure 3. Black francolins fly straight and fairly fast.

Crossbreeds

Based on an inspection of over 6,000 birds of 3 of the subspecies mentioned above, crossbreeding is the rule between subspecies where the ranges overlap. Crosses between the Baluchistan black (henrici) and the Indian black francolin (asiae) are very common in the Indus valley. Species also cross in captivity and probably in the wild as well.

Size and Weight

The largest of the black francolins is the western black (F. f. francolinus), but even the same species from various districts in India and Pakistan vary somewhat in size and weight. Generally those from the northern part of these ranges are the largest. Birds from Sind in West Pakistan and the Deccan in India are noticeably smaller. Males from northern India average about 13 inches, females about 12 inches in length.

In weight, males of the Indian black francolin (F. f. asiae) usually run from 14 to 18 ounces, females from 12 to 16 ounces. Six adult males of the western black (F. f. francolinus), collected near Hillah in Iraq on November 14, 1952 varied between 15 and 20 ounces; 5 females between 14 and 17 ounces. Nineteen males of F. f. asiae trapped near Delhi in January 1962 averaged 17 ounces; 18 females, 15 ounces.

Habitat and Cover Preferences

Cover

Originally the black francolins were probably denizens of tall grasslands and adjacent brushy areas but they have proven also to be well adapted to cultivated crops tall enough to afford shelter and sufficiently open beneath to provide for easy travel. Though not forest birds, brushlands and woods edges are also frequented, but usually in close association with the primary cover types mentioned above. Well-watered habitats or those where the water level in the soil is high are attractive.

In the drier areas, where annual precipitation is often 10 inches or less these birds frequent the stream banks and adjacent jungles, often of tamarisk or of tall grasses and weeds. Equally attractive are the irrigation ditches flanked by weeds and brush with crop or grassland near by. In such situations the birds are seldom found in great number over a mile or two from open water, even though cover, otherwise suitable, is present, unless the general water table in the soil is close to the surface.

It is likely that the factor limiting colonization in desert regions is not the presence or absence of free water for drinking but rather the occurrence of the rank, though open, often succulent vegetation, that is characteristic of many arid areas where water lies close to the surface.



Figures 4-6.
Tall grass,
open beneath
or in clumps,
provides
good cover.





Figures 7-9
Where annual
rainfall is
from 20 to 50
inches, the
vegetation
may be fairly
dense.





Figure 10. A favorite francolin habitat near New Delhi.

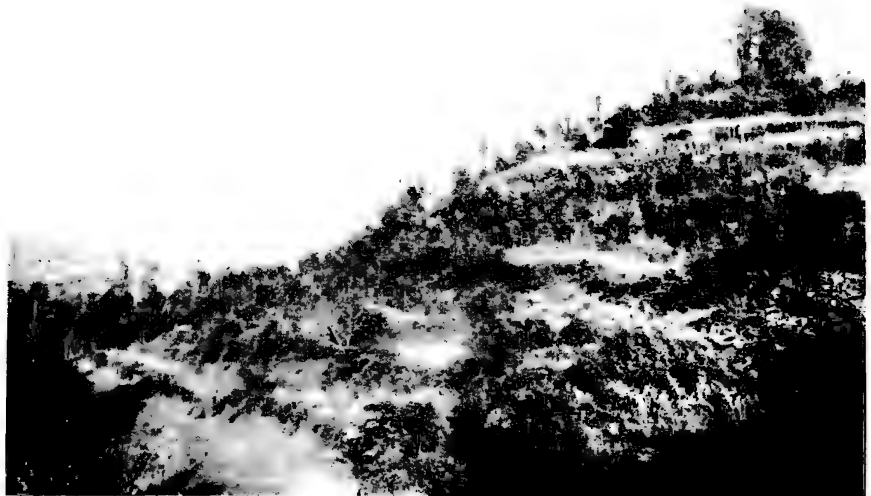


Figure 11. Francolins were common up to 8500 feet near Simla.



Figure 12. Good francolin cover along the Zeb River in Iraq.

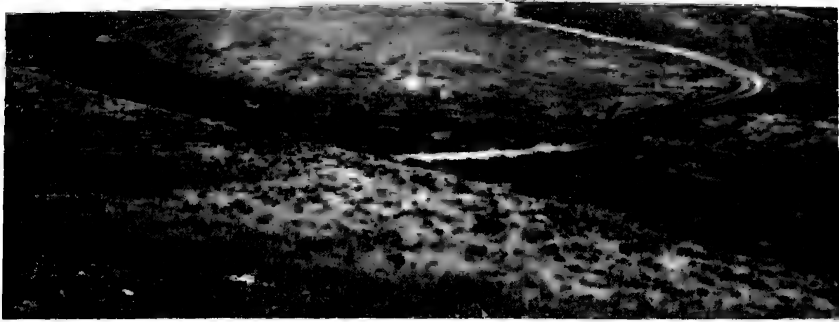


Figure 13. A brushy habitat surrounded by semi-arid plains in Turkey.



Figure 14. Cultivated fields with edge cover are attractive.



Figure 15. Fields of wheat or sugarcane hold many birds.

No unusual demand for water per se has been noted. Dew is heavy over much of the range, and, with metabolic moisture from succulent plants, it appears to provide the water needed over considerable periods of time, both in captivity and in the wild.

In the semi-desert habitats of Iraq and West Pakistan the greatest concentrations of black francolins are usually found in the rather open, though not wet, riverain jungles of tamarisk, other shrubs, grasses, and weeds, in the adjacent croplands, and in oases of date palms.

As precipitation increases the black francolins spread further out into grasslands, scrub, or croplands. Typical cover here includes low lying fields of wheat, barley, rice, mustard, various legumes, millet, sorghum, maize, and cotton with adjacent grassy, weedy, or shrubby patches. The most attractive of all crops in northern India seems to be sugarcane. It is rare that one passes through even a small patch of cane without flushing at least a few black francolins and often gray francolins as well. Clumps of the tall, plumed grass (Erianthes munji) are also likely to hold many francolins, as is alfalfa, where it is present.

Attractive as cultivation is to this species, it is by no means a universal component of their habitat. In the "duns" or flat valleys among the foothills of the outer Himalayas, black francolins are often to be found. Throughout the grass and shrublands bordering the Ramganga River in the Corbett National Park near Ramnagar we found these birds in abundance though far removed from any cropland. Nor were they uncommon in adjacent overgrown forest clearings and some even penetrated the mature forest for short distances. The same was true in pole stands in the Palamau forest of Bihar but only if the trees were sufficiently scattered to encourage an understory of grass and weeds. Cabbage palmetto, grass, and brush held many birds in the rolling foothills of Pakistan's North-west Frontier.

Topography and Elevation

In arid regions most black francolins are found on flat to gently rolling lands where soil moisture encourages the growth of fairly dense vegetation. River banks or the strips of spoil along irrigation ditches also often provide escape cover. Where rainfall is sufficient to encourage more vegetation, slopes, unless quite steep, seem to be no barrier to these birds. In hilly country, they are usually in the valleys though we also flushed francolins high up on cultivated and meadow slopes of the outer Himalayas near Simla up to 8,500 feet.

Soils

Remembering the wide range of topography and precipitation within which black francolins are found and the very extensive distribution of this species, it seems clear that they are at home on a great variety of soil types. In the Indian subcontinent four major types of soils are common within the range of the northern Indian black francolins. The alluvium of the Indo-Gangetic plains is for the most part a sandy to clay

loam, often neutral to alkaline and adequate in phosphorus and potash but sometimes lacking in organic matter. The forest and hill soils, extending well out from the flanks of the Himalayas, are also a sandy to clay loam, often characterized by excessive soil moisture and with a pH varying from 5.6 to 8.4. The arid, semi-desert soils of the southern Punjab and Rajputania are of wind-blown sand to sandy loam, high in pH and in soluble salts, but with little organic matter. There are also large tracts of saline and alkaline soils that are relatively unproductive because of their high content of sodium, magnesium, and calcium salts. Francolins are abundant on all of these soils wherever other habitat conditions are favorable. Interestingly enough the Assam black francolin is also common on the often acidic, alluvial plains of the Brahmaputra River and adjacent hill tracts.

Climate

The genus Francolinus is widely distributed throughout southern Asia and Africa in the tropical, subtropical and lower temperate zones. In their native range, francolins are seldom encountered where average minimum temperatures fall far below freezing in winter though summer temperatures may go up to 120°F in the habitat of some species. Many of the francolins are adapted for existence in arid regions though some, such as the Assam black francolin, thrive where the average annual precipitation is 100 to 150 inches a year.

Throughout the range

Black francolins, climatewise, are among the most adaptable species of the group. Some subspecies occur where average precipitation is less than 4 inches a year, others where rainfall is excessive, often occurring in torrential downpours, between April and October. Snow is not common in black francolin range but the species will withstand more cold than any other group of Asian, and probably African, francolins.

Precipitation patterns over the range of the black francolins vary from almost no rainfall at any time of year to considerable in every month. Between these extremes the only common component is the occurrence of periods of 2 to 5 months in which precipitation is markedly deficient. Five general patterns are recognizable as follows:

1. Very little precipitation at any period of the year. Where this is the dominant pattern, black francolins are found in abundance along the live streams, irrigation ditches and in low-lying areas where water is close to the surface.

2. Considerable precipitation in summer, often with a second period of moderate rainfall in late winter or early spring. This is the pattern through much of India where dry farming is often the rule. In parts of West Pakistan where rainfall is from 3 to 15 inches annually, black francolins are naturally more dependent upon the thicker cover of the Indus floodplain and of irrigated fields. In areas where annual precipitation exceeds 20 inches a year, black francolins may be abundant in crop and tall grasslands even though they are located far from streams or canals.

3. Considerable to excessive precipitation throughout the year except in winter. This is the pattern common to East Pakistan and Assam.

4. Precipitation mainly in fall, winter or spring.

- a. Winters with considerable precipitation
- b. Winter and spring rainfall
- c. Mainly spring precipitation
- d. Rainfall throughout the year except in summer

5. Considerable precipitation throughout the year.

Examples of each pattern are presented in Table 1.

At the stations mentioned in Table 1 relative humidity is generally low except for the periods in which there is considerable rainfall. A heavy dew is characteristic of most of the arid and semi-arid areas throughout much of the year.

Temperatures within the range of the black francolins are generally hot in summer and mild in winter. The highest temperature recorded is 124°F at Hyderabad, West Pakistan. The lowest in India, is 17°F at Simla, though lower temperatures than this have probably been recorded from the region southeast of the Caspian Sea in northeastern Iran and adjacent parts of Turkomen in southwestern Siberia. Francolins liberated in 1960-1961 near Mason Valley in western Nevada survived temperatures down to -12°F at night (12).

Climacurves showing the average maximum and average minimum temperatures by months in relation to precipitation, constructed from data covering 34 stations within the range of the black francolins (23 and 33) are presented in figure 16. The upper curve on each diagram represents the warmest average maximums recorded, the lower curve, the coldest average minimums in relation to various amounts of monthly precipitation. All stations are located in areas where black francolins are known to be abundant.

For the northern black francolin

The climacurves presented in figure 16 cover the entire range of the species. The temperature and precipitation levels that characterize the range of each subspecies, while falling within the upper and lower limits presented for the species as a whole, may vary considerably.

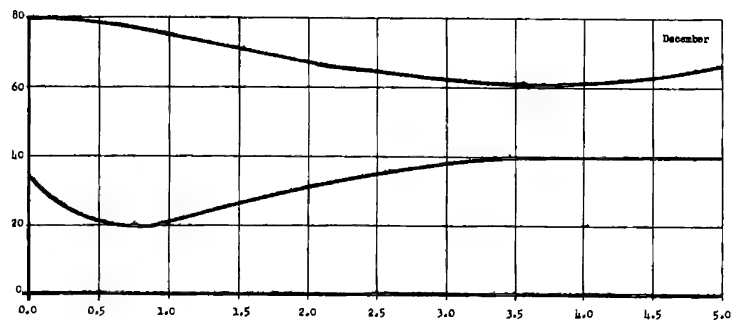
Only the northern black francolin (F. f. *asiae*) has been widely collected for trial introduction into the United States (11). This is also the subspecies that is being commonly propagated on State game farms for release. The source of this stock is the lower Indus valley in West Pakistan and the plains between Meerut, Agra and Lakhimpur in northern India.

Table 1. Precipitation Over the Range of the Black Francolin
Tabulated According to Pattern

			Average monthly precipitation (in inches)												Av. Annual Precip.	
Pattern	Country	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
1	W. Pak- istan	Jacobabad	0.2	0.3	0.2	0.2	0.1	0.3	0.9	0.9	0.2	T	T	0.2	3.6	
		Sukkur	0.2	0.3	0.2	0.1	0.1	0.1	1.1	1.1	T	T	0.0	T	3.7	
		Bahawalpur	0.2	0.3	0.4	0.2	0.2	0.3	2.2	1.3	0.1	0.1	T	0.2	5.6	
2	Iraq	Baghdad	0.9	1.0	1.1	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.8	1.0	5.5	
		Hyderabad	0.2	0.2	0.2	0.1	0.2	0.4	3.0	2.0	0.6	T	0.1	0.1	7.1	
		Karachi	0.5	0.4	0.3	0.1	0.1	0.7	3.2	1.6	0.5	T	0.1	0.2	7.7	
	W. Pak- istan	Peshawar	1.4	1.5	2.4	1.8	0.8	0.3	1.3	2.0	0.8	0.2	0.3	0.7	13.6	
		India	Jaipur	0.4	0.3	0.3	0.2	0.6	2.2	7.7	8.1	3.2	0.5	0.1	0.3	24.0
		New Delhi	1.0	0.8	0.5	0.3	0.5	3.0	7.0	7.2	4.8	0.4	0.1	0.4	26.2	
		Ludhiana	1.5	1.4	0.9	0.6	0.5	2.3	8.1	6.7	3.9	0.4	0.1	0.7	27.2	
		Indore	0.2	0.1	0.1	0.1	0.5	5.8	11.1	8.2	6.5	1.2	0.6	0.3	34.7	
		Lucknow	0.8	0.7	0.3	0.3	0.8	4.5	12.0	11.5	7.4	1.3	0.2	0.3	40.0	
		Ranchi	0.9	1.8	1.2	0.9	2.1	8.6	15.4	13.8	9.3	3.1	0.6	0.3	58.0	
	Sikkim	Yatung	0.6	2.2	2.1	3.9	4.1	5.7	6.4	6.1	4.3	1.9	0.4	0.4	38.1	
	Nepal	Katmandu	0.4	1.7	0.6	1.0	5.1	9.7	14.7	13.7	7.2	1.4	0.1	0.3	55.8	
	3	India	Gauhauti	0.4	1.2	2.0	5.7	9.3	12.3	12.3	10.3	6.6	2.8	0.5	0.2	63.5
Shillong			0.5	1.1	2.0	5.1	11.3	18.2	13.6	12.5	11.8	6.7	1.6	0.3	84.6	
Darjeeling			0.5	1.2	1.9	4.1	9.6	24.2	32.9	26.6	18.9	5.4	0.8	0.3	126.4	
	E. Pak- istan	Nagargang	0.3	1.2	2.4	5.4	9.6	12.4	13.0	13.3	9.8	5.3	1.0	0.2	73.8	
		Chittagong	0.2	1.1	2.5	5.9	10.4	21.0	23.5	20.4	12.6	7.1	2.2	0.6	107.6	
	4(a)	Cyprus	Nicocea	2.9	2.0	1.3	0.8	1.1	0.4	0.1	0.1	0.2	0.9	1.7	3.0	14.6
	W. Pak- istan	Pashi	1.9	1.4	0.5	0.4	T	0.3	0.5	0.2	0.0	0.0	0.1	0.8	6.2	
		Kalat	1.3	1.4	1.1	0.6	0.2	0.2	0.6	0.3	0.1	0.1	0.2	0.9	7.0	
	(b)	Iraq	Mosul	2.8	3.1	2.1	1.9	0.7	0.1	0.1	0.1	0.1	0.2	1.9	2.4	15.5
(c)	USSR	Ashkabad	1.0	0.8	1.9	1.4	1.2	0.3	0.1	0.1	0.1	0.5	0.8	0.7	8.9	
(d)	Turkey	Anatolia	10.2	6.9	3.1	1.5	1.3	0.5	0.1	0.1	0.6	2.1	4.7	10.5	41.7	
		Adana	4.3	4.0	2.5	1.6	2.0	0.7	0.2	0.2	0.7	1.9	2.4	3.8	24.3	
	Iran	Gurgan	1.0	2.0	2.2	2.4	1.2	1.0	0.8	0.5	1.0	1.2	1.2	1.0	15.5	
5	India	Srinagar	2.9	2.8	3.6	3.7	2.4	1.4	2.3	2.4	1.5	1.2	0.4	1.3	26.0	
	USSR	Lenkoran	4.7	3.3	3.7	2.6	1.5	0.9	1.1	1.8	8.6	8.4	7.7	5.0	49.3	

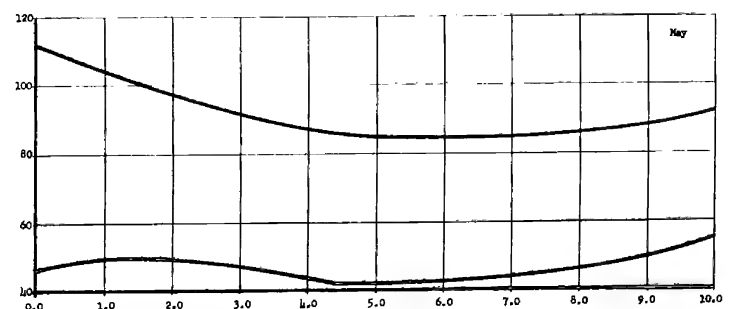
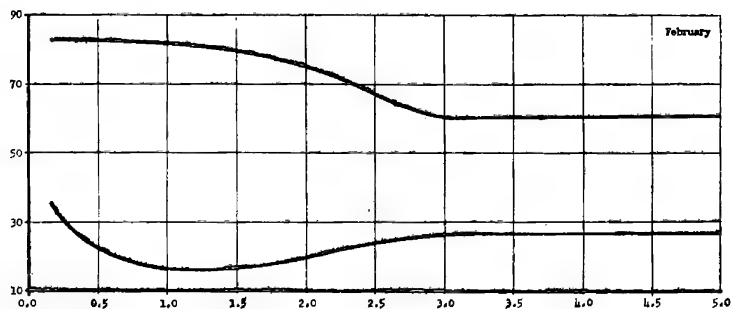
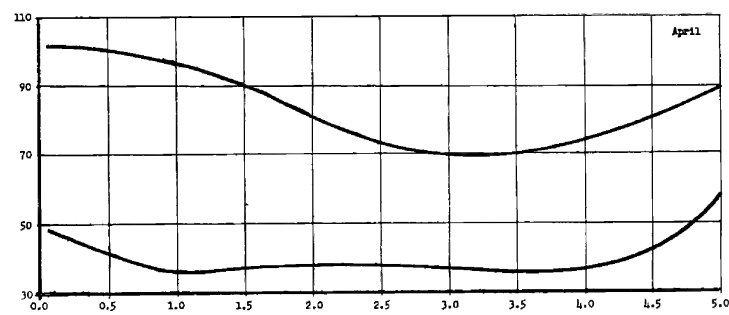
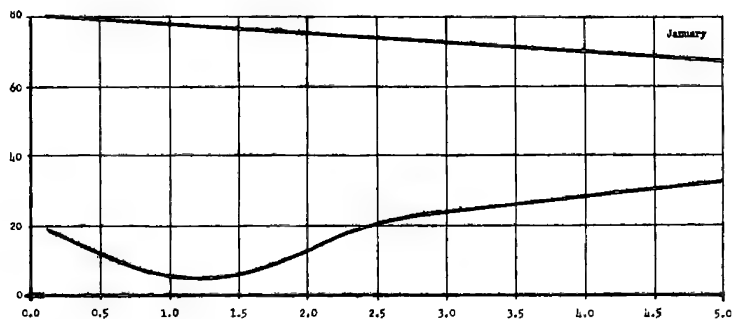
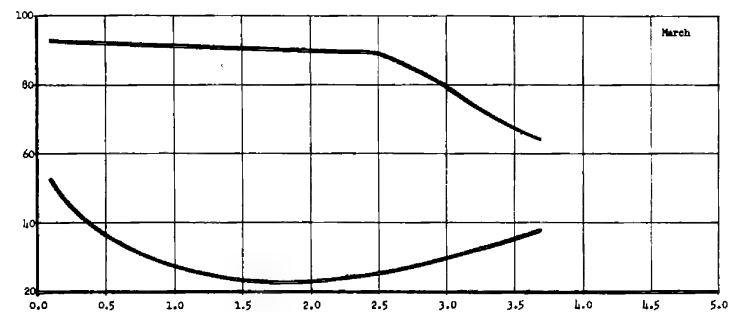
Figure 16. The range between the average of the maximum and of the minimum temperatures according to average precipitation, by months, within the distribution of Francolinus francolinus.

Temperature in degrees F.



Average maximum

Average minimum

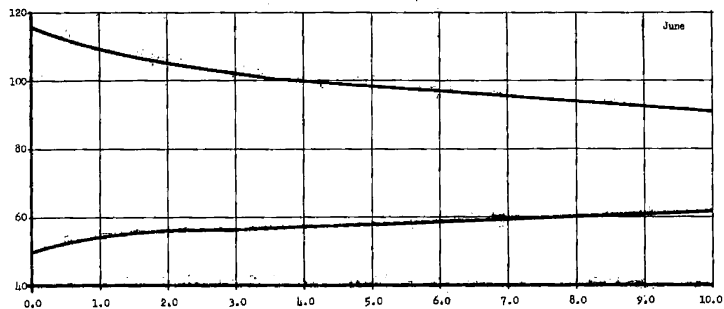


Precipitation in inches

Precipitation in inches

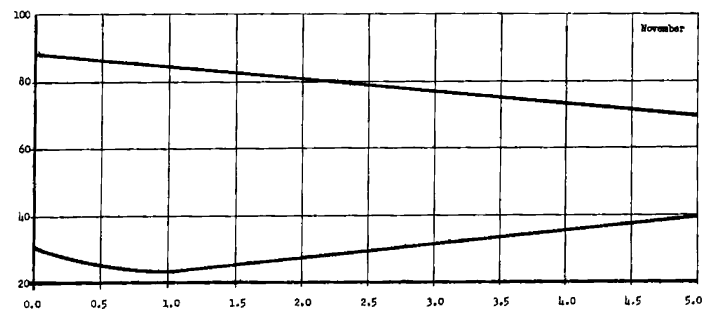
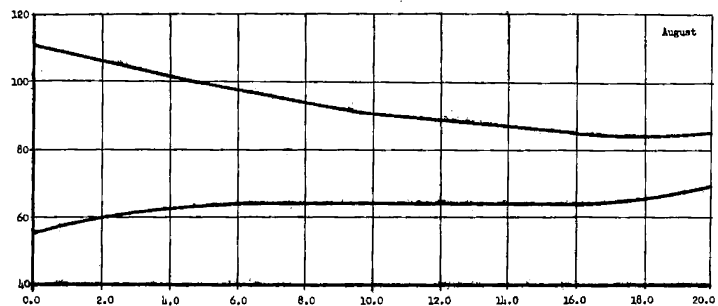
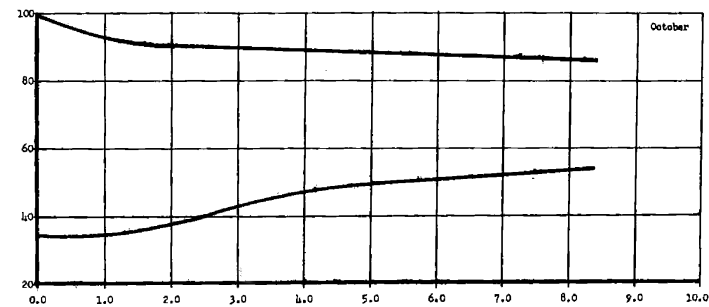
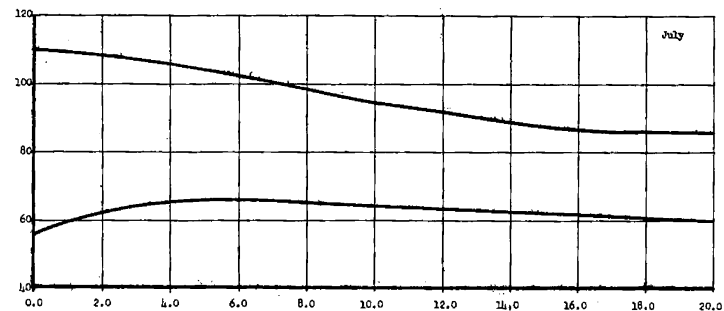
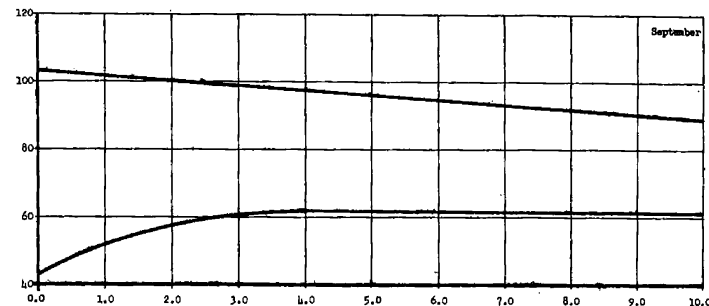
Figure 16. The range between the average of the maximum and of the minimum temperatures according to average precipitation, by months, within the distribution of Francolinus francolinus - (cont'd.)

21
Temperature in degrees F.



Average
maximum

Average
minimum



Precipitation in inches

Precipitation in inches

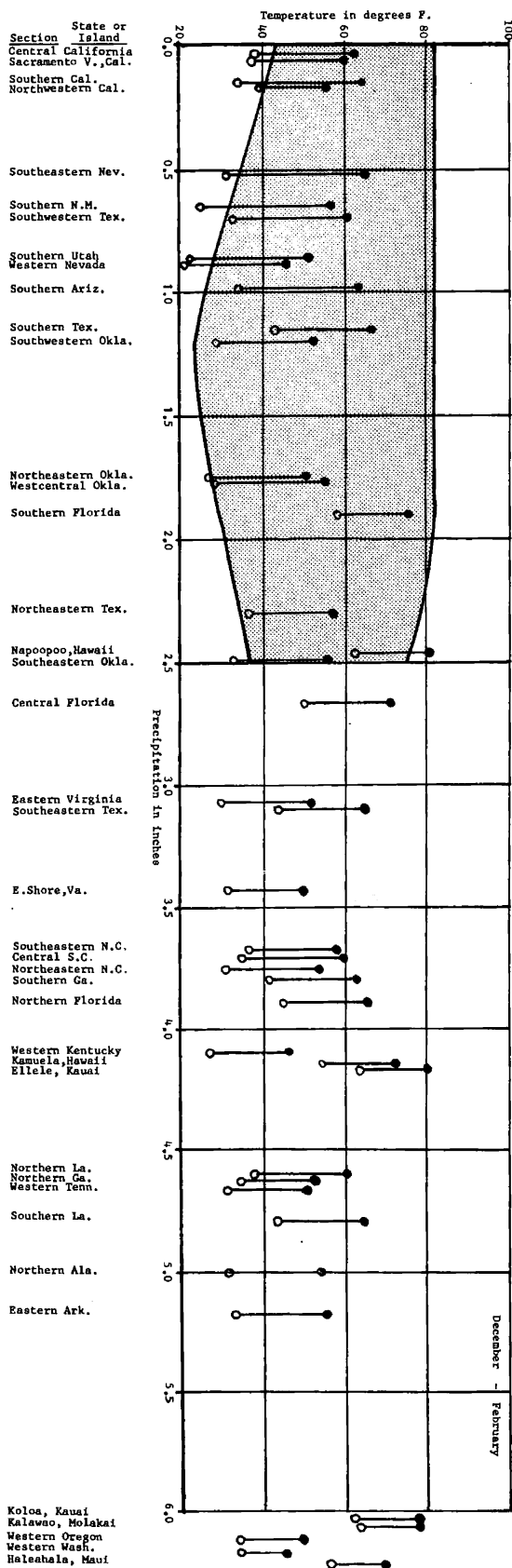
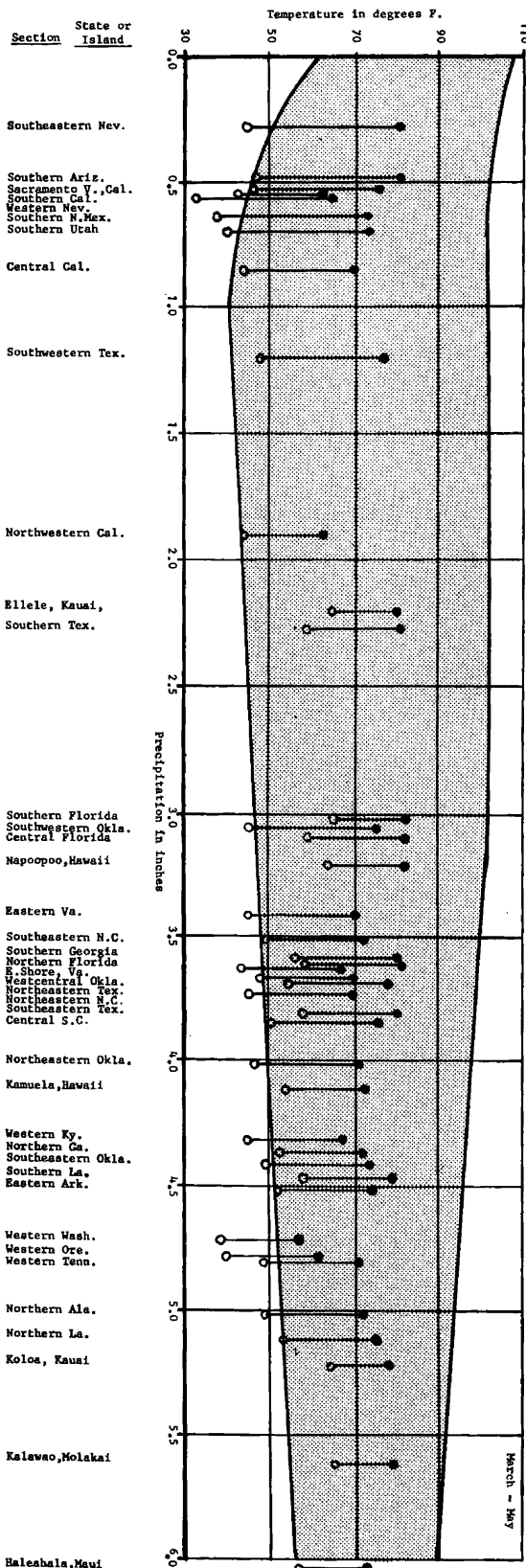
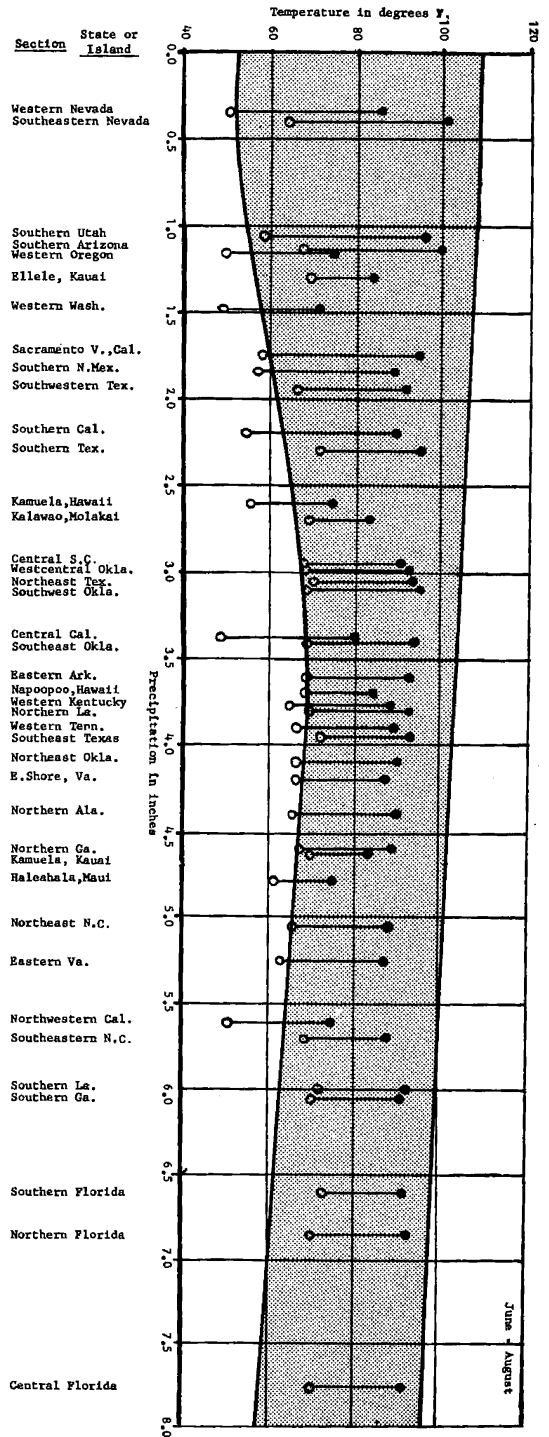
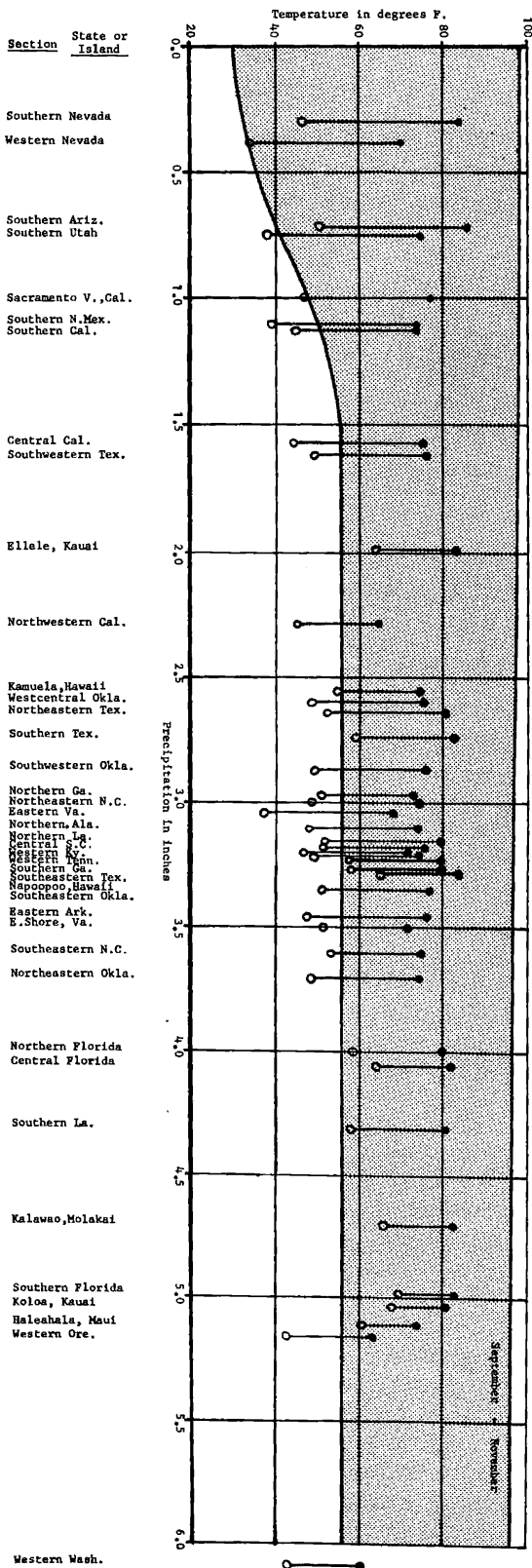


Figure 17. Average maximum and average minimum temperatures according to precipitation, by seasons, for parts of the United States compared with similar data from the range of the northern black francolin.



Seasonal comparisons of climate, typical of the range of this subspecies with that characteristic of some parts of the United States, were prepared to assist those interested in the selection of trial release areas potentially suitable for this subspecies. On this separate group of climacurves were plotted the average maximum (black circle) and average minimum (white circle) temperatures for parts of 18 States, mostly in the South or Southwest. The two circles were then connected by a black line for ready identification. These climacurvic comparisons are presented in figure 17.

In general, temperatures, within the native range of the northern black francolin, are inclined to be somewhat higher especially in spring and fall than they are in southern and southwestern States. Winter average minimums here are generally close to those in India and Pakistan though on the low side. Summer temperatures fall well within the averages given for the native range with two exceptions. In only a few cases would these differences appear to be of sufficient magnitude to rule out the possibility of survival in the sections here considered.

Food and Water

An omnivorous feeder, the black francolin takes a wide variety of plant and animal foods. Waste grain, weed seeds, many insects, greens and some miscellaneous grit and trash constitute its normal diet but more bizarre items are not shunned.

A careful review of the literature, including the Journal of the Bombay Natural History Society from 1900 to date, disclosed very few references to francolin food habits. With the western black francolin (F. f. francolinus) we were no more successful. In four birds shot on November 18, 1950, near Mosul, Iraq the following was found: 1. 50% wheat, 50% one kind of weed seed. 2. 95% large fleshy red fruit, 5% weed seeds. 3. 98% wheat, 2% weed seeds. A fourth crop was empty. Six birds shot near Kut, Iraq on the following day contained the following: 1. 100% grasshoppers. 2. 30% grasshoppers, 70% wheat. 3. 90% wheat, 10% weed seeds. 4. 60% wheat, 40% two species of weeds. 5. 100% wheat. 6. 40% wheat, 58% large black ants and 2% weed seeds. Birds collected from Hillah, Iraq on Christmas Day, 1951 were full of date pulp. Members of The Mesopotamia Expeditionary Force "D" (35) indicate that "from one killed near Belid, Iraq, 284 grains of barley were taken but there is also a balance on the other side as Buxton found another bird crammed with the harmful locust (Decticus albifrons)."

For the northern black francolin (F. f. asiae) there was only one definitive food study reported. C. E. Mason (34) an entomologist, identified the insects and a few of the plants found in the crops of 30 birds collected mainly in summer near Delhi. To expand this picture, Shamin A. Faruqi, botanist at Sind College, Karachi, and Bump examined

the crop contents of 23 black francolins collected seasonally between Karachi and Sukkur, West Pakistan in 1955-1957. The results were published in the Journal of the Bombay Natural History Society, Faruqi et al (20) and are reproduced here for ready reference.

"The study indicates clearly that this species is omnivorous. A total of 19 different genera of plants and 4 orders (including 12 species) of insects were found in the crops examined: In addition, one bird had eaten an earthworm, one a spider, two more had fed almost entirely on human excrement, and one, collected after a rainstorm, had swallowed a 1½ inch toad. Of the 23 birds examined 2 had consumed insects only, 9 plants only, and 12 had eaten both.

"Insects are eaten at all seasons of the year. Ants and beetles were commonly found in the crops, although wasps and flies were also identified. One bird, collected in August, had eaten 21 ants, 1 earthworm, 4 unidentified larvae, about 500 small pink midges, and a spider.

"Plants, however, make up the bulk of the food of the black francolin throughout the year. Seeds of mustard (Brassica campestris), wild pea (Lathyrus sativus), cultivated grain, and grass seed were most commonly eaten. Parts of 20 different species of plants were identified which included seeds, fruits, tubers, grains, leaves, and a small amount of roughage in the form of twigs, husks, and dried grasses.

"In winter the wild pea and the common mustard are favorite foods. One bird shot in February had made a meal of 250 wild peas; another, of over 300 mustard seeds with some leaves from the same species.

"In spring, with the harvesting of the winter grains underway, the birds often turn their attention to wasted wheat (Triticum vulgare), barley (Hordeum sp.), and rice (Oryza sativa) whenever they are available, although other seeds are by no means avoided. One bird, collected in April, had scratched up and eaten 12 large tubers of a desert sedge (Cyperus arenarius) and others had fed largely on wild peas.

"It is during the summer and fall, however, that the black francolin seeks out a great variety of plant foods. Most of those mentioned above were commonly found in the crops examined, but the largest number of seeds and inflorescences were from four genera of grasses that ripened at this time. One individual, collected in September, had a full crop of 1850 grass seeds representing four species, 250 seeds of Indian mallow (Abutilon sp.), one seed of Rhynchosia sp., and five other seeds, still unidentified. Another bird, shot in October, had consumed about 1000 seeds of Setaria verticillata and 54 seeds of three other grass species."

Table 2 gives the seasonal analysis of foods eaten, as listed by Faruqi et al.

Table 2. Foods eaten by the Black Francolin according to season and number of crops in which each was found

	<u>Foods</u>	<u>Parts Eaten</u>	<u>Season</u>			
			Sp.	Su.	Fall	Wi.
<u>Plant</u>						
<u>Abutilon</u> sp.	Indian mallow	seeds		1		
<u>Brassica campestris</u>	mustard	seeds				2
<u>Cephalandra indica</u>	a cucurbit	seeds		1		
<u>Cyperus arenarius</u>	flat sedge	rhizome	1			
<u>Dactyloctenium aegyptium</u>	a grass	seeds		1		
<u>Dactyloctenium scindicum</u>	a grass	inflorescence		1		
		seeds		1	1	
<u>Echinochloa colonum</u>	jungle rice	peduncle			1	
		seeds		2		
<u>Eriochloa procera</u>	a wild millet	inflorescence		2		
<u>Hordeum</u> sp.	a barley	seeds	3			
<u>Lathyrus sativus</u>	wild pea	seeds	1			7
<u>Lathyrus</u> sp.	a pea	seeds	1			
<u>Launaea nudicaulis</u>	a compositae	inflorescence				1
		leaves				1
<u>Mukia scabrella</u>	a cucurbit	fruit		2		
		seeds		2		
<u>Oryza sativa</u>	rice	seeds	3	3		
<u>Panicum miliaceum</u>	broom corn millet	seeds	1			
<u>Pennisetum typhoideum</u>	bajra, a millet	seeds	1			
<u>Phaseolus mungo</u>	pulse	seeds		1		
<u>Rhynchosia</u> sp.	a legume	seeds		1		
<u>Setaria verticillata</u>	bristlegrass	seeds		1	1	
<u>Solanum nigrum</u>	black nightshade	fruit				1
<u>Triticum vulgare</u>	wheat	glumes	1			
		leaves				1
		seeds	2	1		
<u>Animal</u>						
<u>Hymenoptera</u>	small black ants	whole		3		
	medium black ants	whole	5	1		1
	large black ants	whole	1	1		
	red ants	whole	1	1		
	wasp	whole		1		
<u>Diptera</u>	fly	whole		1		
	midge	whole		1		
<u>Coleoptera</u>	small black beetle	whole		1		
	medium black beetle	whole		1		
	large black beetle	whole	1	1		
	striped beetle	whole				1
	brown beetle	whole	2			
<u>Araneae</u>	spider	whole		1		
<u>Pheretima</u> sp.	earthworm	piece		1		
<u>Bufo</u> sp.	toad	whole	1			
<u>Miscellaneous</u>						
	human excrement					2
	grit					1

To bring together all available information in one place, G. E. Mason's list of foods is reproduced in Table 3.

Table 3. Foods consumed by 30 Black Francolins (F. f. asiae) collected near Delhi, India, in 1912

<u>Foods</u>	<u>Parts Eaten</u>	<u>Season</u>			
		Sp.	Su.	Fall	Wi.
Vegetable					
Oats	seed	4	16		2 (a)
Wheat	seed	1	5		1
Millet	seed		2		
Oats	husk		2		
Oats	blade		1		
Pea	seed		1		
Wild fig	fruit		1		
<u>Abrus precatorius</u>	seed		1		
24 different, unidentified wild legumes	seed	9	many		4
Animal					
<u>Camponotus compressus</u>		4	15		2
<u>Himatismus</u> sp.		3	16		
<u>Aecophylla smaragdina</u>		1	8		1
<u>Mesomorpha villiger</u>		2	5		1
<u>Opatrum</u> sp.			5		1
<u>Polyrachis simplex</u>		1	5		
<u>Mylocherus discolor</u>			5		
<u>Myrmecocystus setipes</u>			5		
<u>Cydnis nigrinus</u>			4		
<u>Mylocherus blandus</u>			4		
<u>Opatrum depressum</u>			3		1
<u>Schenoptera gossypii</u>		1	2		
Weevil		1	2		
Spider		1	1		
<u>Gastromargus</u> sp.			2		
<u>Brachytrypes achatinus</u>			2		
<u>Hister opacus</u>			2		
<u>Hister bipustulata</u>			2		
<u>Elaterid</u> sp.			2		
<u>Acantholepis frauenfeldi</u>			2		
<u>Trox indicus</u> (?)			2		
<u>Cydnis</u> sp.			2		
<u>Crematogaster subnuda</u>			2		
Grasshopper	whole		1		
	jaw		1		
	head		1		
<u>Cicindelid</u>			1		
<u>Sphex lobatus</u>			1		
<u>Chrysis</u> sp.			1		
<u>Melolonthid</u>			1		
Small caterpillar			1		
<u>Agrotis segetis</u>			1		
<u>Lamellicorn</u>			1		

(a) Number of crops in which this food was found.

<u>Foods</u>	<u>Parts Eaten</u>	<u>Season</u>			
		Sp.	Su.	Fall	Wi.
<u>Animal</u>					
<u>Myrmeleo</u>	larvae		1		
<u>Pompilus subsericeus</u>			1		
<u>Mutilla discreta</u>			1		
<u>Phidole malinsi</u> (?)			1		
<u>Scleron orientale</u>			1		
<u>Bolboceras catanus</u>			1		
<u>Caccobius vulcanus</u>			1		
<u>Gymnopleurus miliarus</u>			1		
<u>Onthophagus bonasus</u>			1		
<u>Nezara viridula</u>			1		
<u>Cydnis varians</u>			1		
<u>Geotomus pygmaeus</u>			1		
<u>Homaecerus inornatus</u>			1		
<u>Graptostethus servus</u>			1		
<u>Graptostethus dixoni</u>			1		
<u>Storthechoris nigriceps</u>			1		
<u>Dermatinus lugubris</u>			1		
<u>Membracid</u>			1		
<u>Jassids</u>			1		
<u>Grubs</u>			1		
<u>Diptera</u>	pupae		1		
<u>Macrochilus tripustulatus</u>			1		
<u>Leptid fly</u>			1		
<u>Acridium aeruginosum</u>			1		
<u>Meranoplus bicolor</u>			1		
<u>Aphodius marginellus</u>			1		
<u>Opatrum mesonotum</u>			1		
<u>Scleron orientale</u>			1		
<u>Coprid sp.</u>		1			
<u>Monophlebus octocaudata</u>			1		
<u>Clavigralla horrens</u>			1		
<u>Gymnopleurus parvus</u>		1			
<u>Onthophagus dama</u>		1			
<u>Agrostis sp.</u>		1			
<u>Serica lugubris</u>			1		
<u>Myllocerus sp.</u>			1		
<u>Penthicus sp.</u>			1		
<u>Tanymecus hispidus</u>			1		
<u>Carabid</u>			1		
<u>Hapalochrus fasciatus</u>			1		
<u>Pulvinaria sp.</u>			1		
<u>Miscellaneous</u>					
Red brick	piece		6		
Stone		1	4		
Green glass bead			3		
Stick	bits		1		
Quartz	small piece		1		
Shot		1	1		
Glass	bits	1			
Coal	bits	1			
Red bead			1		

Other reports on foods eaten were fragmentary. Biswas (7) found the remains of maggots in the stomach of a francolin shot near Thankot, Nepal. Baker (4) in referring to the Assam black francolin, indicates "when hill rice is ripe, they are fond of lying up in the thick cover and birds shot from there have crops full of rice."

Water for drinking apparently poses few problems, in part because over much of the range dew is heavy and commonly used, in part because of the amount of succulent vegetation and insects eaten. The provision of fresh lettuce daily, when birds are penned, markedly reduced their interest in the water also provided. Baker (4) quotes Pittman as saying that F. f. henrici drink regularly morning and evening, an observation not confirmed by our own field work.

General Habits

Movements and Mobility

Francolins are nonmigratory and, to us, did not appear to move far from their home coverts even in the face of a very occasional snowfall but there were unconfirmed reports that birds will travel 30 to 40 miles to tall sugarcane. Baker (4) indicates that they shift from thicker cover into fields, long grass, or open scrub to feed in early morning and late afternoon. He further states that in autumn and the early part of winter, individuals, especially the young, straggle considerable distances from the jungle.

In our experience these birds appeared to be quite sedentary even when wild-trapped, moved, and liberated in a new location. Few reports of birds being seen over 5 miles from the point of release, within the first year thereafter, have been received from State wildlife biologists who have released over 5,000 wild-trapped individuals in various coverts in the United States. Even in the second and third years, it was the exception to find these birds over 10 miles from the area of liberation.

Normally black francolins prefer escape by flying rather than by running unless harried. When frequently hunted they soon learn to run through the cover in a sort of loping walk that can still keep them well ahead of a sportsman with a gun.

Flight

Black francolins fly straight though seldom high, often preferring to keep within 10 to 20 feet above ground or cover. They do not appear to be as fast on the wing as bobwhite or Hungarian partridges but are nevertheless easy to miss with a shotgun. Flight distances seldom exceed 500 feet unless suitable cover is farther removed. Once settled in, birds are apt to sit tight if the cover is dense or to run if it is open.

Country folk in Iraq commonly stated that rain-drenched black francolin were often incapable of flight. We never met with a bird in this condition but did note that blacks in our pens, thoroughly soaked by monsoon rains, were understandably sluggish and easy to catch by hand.

Wariness

In its native range we never considered the male black francolin to be a particularly wary bird. We have pursued birds for considerable distances on foot in open cover without flushing them. Calling males sometimes may be approached within 75 feet before they take wing or sneak to another calling location, seldom far away. Surprised at the edge of a covert they are more likely to melt into it rather than to seek escape by flying.

Females are much more secretive. Especially when the cocks are calling, one is apt to see a dozen cocks to one hen. Yet in hunting, no great difference in wariness was observed between the sexes. Broods are particularly difficult to find.

In captivity blacks tame down rather more quickly than gray francolin but seldom get as completely accustomed to man as do hand-raised grays.

Resting and Roosting

Black francolins normally rest and roost on the ground, usually in fairly dense cover that is open beneath. In Turkey, brushy clumps, in Iraq tamarisk thickets, and in Pakistan and India brushy, weedy or grassy clumps or tangles were common places for concealment. Fields of wheat, barley, cotton, mustard or of leguminous crops were frequently utilized. Fields of sugarcane were most attractive of all. Birds could usually be trapped or flushed there at all hours of the day. We never saw a black francolin roosting on a branch at night though the male birds frequently use such, often exposed, perches for calling. But among penned birds there were usually a few that roosted on flat boards or bamboo poles projected crosswise through the pens.

Nesting and Renesting

The literature contains many records of nests located between April and September. Country folk in southern Turkey reported some nesting by late March, as does Baker for Assam, but we are convinced that these birds may breed both earlier and later given favorable conditions. A black female trapped for us near Meerut, northern India, on February 24 contained an egg ready to be laid. A youngster not over three weeks old was netted in the same locality on November 5 and all through the winter and into March small numbers of birds 1/3 to 1/2 grown were delivered to us by our trappers. Baker quotes Whympers as reporting a nest of eggs near Nanital, northern India at 5,000 feet on October 21.

In some desert areas certain birds are known to breed largely with the advent of or during the rainy season. There seems to be a clear case for this with the northern black francolin. In southern Turkey and northern Iraq there are winter and spring rains but the summer is dry. Here the francolins normally nest from March to May. But in India when monsoons are from the northeast in late winter and from the southwest in summer, the black francolins may breed anytime from February through November. A good northeast monsoon, that brings two inches of rain or more



Figure 18. Egg of chukar (left), gray (top) and black francolin (right).



Figure 19. Black francolin nests are sometimes well-concealed.



Figure 20. Many are in more open spots as in the weeds in the foreground.

to the plains in late winter will encourage very early nesting. When this monsoon is weak many francolins will not nest until the onset of the southwestern monsoon in June. Baker (4), in referring to the Assam francolin, expressed the probable reason for this as follows: "Everywhere the time is governed by the abundance of foods, and this in turn depends on the rainfall and the time of year the natives burn off the grass."

The nest is usually placed on the ground in a small depression lined with grass or other leaves, sometimes very casually constructed, but often neater and more substantial. Under a tuft of grass or in a small thick clump of weeds or low shrubs are common locations but some are also found in fields of sugarcane, mustard or indigo at some distance from grassy or brushy patches. Israeli field biologists reported nests in alfalfa and clover fields. Where black francolin have been liberated in Louisiana, State biologists found several nests in grassy clumps between the rows in a large field of cotton. Others have been found in soybeans, along irrigation ditches, and one, in Hawaii, in alfalfa.

Renesting, following the destruction of the first nest, has not actually been observed but almost certainly is the rule. Likewise it is probable, though not certain, that many birds will rear a second brood.

Eggs

Hume (26) and Baker (4) agree that nests average 6 to 8 eggs though Jerdon (29) reports 10 to 12 as did country folk in southern Turkey. Baker describes their color as varying from pale stone (rare) to deep olive or chocolate brown, the majority being pale olive brown to almost an olive green. In shape they are spherico-conoidal to oval with the larger end being almost flat on occasion. Hume (26) found the average measurement of 70 eggs to be 39.8 x 33.0 mm. The eggs of F. f. melanonotus are slightly smaller.

The incubation period for black francolins is 18 to 19 days. In captivity in 1963, Florida biologists secured an average of 31 eggs per hen from breeders one to two generations removed from the wild.

Brooding and Rearing

Almost nothing is known of the behavior of the mother and chicks once they have left the nest. They are certainly extremely shy. It was very unusual for our trappers to find birds under six weeks of age in their nets but at least 300 youngsters from 2 to 5 months old were caught. Since young birds should normally be more numerous than adults in the coverts trapped, it would appear that youngsters are more apt to remain immobile when the rope is pulled through the vegetation above them or the beaters walk by. Hume (26) states that young birds soon learn to shift for themselves and are separated from their parents by November.

Gregariousness

Black francolins never gather in flocks nor are they usually observed in family parties. Normally birds were found well-scattered throughout the cover and it was not common to put up two birds together though they might be only 25 to 50 feet apart. Very occasionally, we have flushed as many as five francolins from an acre of sugarcane but for the most part, they are more widely scattered. Baker indicates that hen and cock remain together throughout the year; Frome (22) believes them to be solitary.

During the breeding season from March through September males are often seen or heard calling but never two from the same branch or rise of ground. When cocks were calling from all directions, Baker never saw a vocal bird challenged or even approached by another, although our trappers in Pakistan caught over 500 birds, mostly males, using male callers.

Psychology and Behavior

In the wild, the adult black francolin is generally a more phlegmatic bird than is its gray cousin. Yet day-old chicks in a brooder are so wild and easily disturbed that they injure themselves or even die of shock much more readily than do quail or pheasant chicks. Once the youngsters are a month old they settle down, often becoming fairly tame. Males, even during the breeding seasons are not particularly pugnacious, though in West Pakistan, on two occasions, we did come upon a pair of cocks in vigorous combat. Even at this period they never seem to bother other birds either in captivity or in the wild.

Psychologically they are more complex birds than are the gray francolins. The blacks are slower, but their reactions in captivity are less predictable. Adults, being dusted for lice, often picked at our fingers and hung on tenaciously. Occasional trouble was also encountered from cannibalism when numbers were closely confined together. Where heavily hunted, they learn rapidly to run rather than to trust to their wings.

Calls

The call of the male black francolin is so unlike that of other birds that it must be heard to be believed. First, there is a low guttural note similar to a click of the tongue, followed immediately by zzzzeeee, zzzzeeee, zzee, zzee, which to us sounds not unlike a cicada. Hume (26) translates this into, "Be quick pay your debts," the muslims into, "Subhan, tere kudrut." (Oh, Omnipotent One, Thy power who shall fitly describe?). A favorite campfire description is "Lehsan, piaj, adrakh" (garlic, onions, ginger) and the British Tommies gave to it an understandingly military connotation as "fixed bayonets, straight ahead." Thornhill (50) indicates that "in Mesopotamia the call is shriller than in India and contains an extra syllable." On a still day the call may be heard for at least a third of a mile. When surprised the bird rises without cackling and we have never heard the female utter a call of any kind.

During the breeding season the male birds may call from a prominent perch at any time of day, though early morning and late afternoon, into the dusk, are perhaps preferred. As the season progresses, they are apt to call less often and then usually when the day is cloudy, wet or still. There is apt to be a resurgence of calling in late summer but in fall and winter they are often almost silent though on one occasion Bohl heard many males calling as late as November 22 in northern India.

Interbreeding

As previously indicated subspecies cross readily where ranges overlap and the various species of the black francolin will interbreed, at least in captivity. No crosses between the black and the gray francolins are recorded either in the wild or in captivity.

Predation

Throughout their range, black francolins are exposed to predators in variety and numbers at least comparable to those present in the United States. In India, mongoose and jungle cats are common. From 1960 to 1962 we killed 18 full grown jungle cats (Felix chaus) and 5 mongooses in our compound at the edge of New Delhi, in which our birds were conditioned for shipment. Scrivastava (49) witnessed a "partridge" being caught by the Indian lynx (Caracal caracal) near Saharanpur. Foxes are less in evidence but jackals are common as are hawks and great-horned owls. No unusual losses from predators are reported in the literature or were observed by us or our trappers.

Reproductive Capacity

There exists an unfortunate hiatus in our knowledge of the reproductive capacity of this species. But the demonstrated abundance of these birds, where conditions are favorable, fosters the thought that it must be substantial. The facts, so far as is known, are as follows:

Breeding age -- Black francolins breed the first year following hatching.

Number of eggs -- Normally 6 to 8 with up to 15 reported by some writers.

Brood survival -- No information.

Life span -- In captivity up to 6 or 7 years.

Sex ratio -- In India where these birds were caught by driving them into nets it was normal to catch about 55 to 60 percent females and 40 to 45 percent males. Since the males are generally considered to be easier to trap than the females, it is probable that the sex ratio is unbalanced in favor of the latter.

Renesting -- Probably will renest if the first nest is destroyed.

Second broods -- Several authors state that the female commonly nests twice in a season. The very wide seasonal distribution of young birds trapped tends to bear this out.

Diseases and Parasites

Black and gray francolins in Asia seem to have a normal complement of diseases characteristic of gallinaceous game birds. Program personnel, under the tutelage of Drs. Earl Moore and Eric Carver, U. S. Technical Cooperative Administration pathologists assigned to India, made it a point to thoroughly examine all sick birds received. Program biologists were not technically qualified to identify to genera and species, many of the parasites observed. Yet our identification of diseases and parasites was sufficiently detailed to permit the elimination of most of them by proper flock management and/or treatment during the two months quarantine period in India. As a result, of 6,033 birds shipped from India to the U.S.D.A. Quarantine Station near New York or Honolulu only 6 died in transit in the winter of 1961-62.

All of the diseases mentioned below were identified by Program biologists or by poultry pathologists in India. Following the shipment of the birds to quarantine in Clifton, N.J. or Honolulu, Hawaii, only Newcastle disease, fowl pox and a few parasites were reported during the 3-weeks quarantine period.

Diseases

Protozoan -- Coccidiosis was fairly common in wild black francolins. Dr. Moore, who examined some birds for this protozoan, identified no new species.

Histomoniasis or blackhead was observed in these francolins in only one of the three years covered by the study and then only in a few birds.

Bacterial or virus -- Fowl cholera was identified from several groups of birds trapped and penned in 2 of the 4 years in which francolins were conditioned in India. Losses from this disease were not heavy.

Fowl pox is endemic in francolins in Pakistan and India though the number of birds infected in the wild appears to be small. It was usually easily controlled by the prompt isolation of infected birds in captivity.

Hexamitiiasis, or coryza-like infections, were not uncommon in wild-trapped birds.

Non-specific enteritis of the intestine was fairly common in captivity.

Newcastle disease or ranikhet, as it is called in India, is extremely widespread in poultry and is probably casually endemic in wild francolins in that country, though possibly contracted from wide-ranging domestic birds. It was found impossible to pen large numbers of francolins together without sooner or later experiencing a serious outbreak of, and substantial losses from, this disease. Birds injected with 0.5 cc of most strains of killed vaccine, obtained from the United States, were protected from the disease when penned in India but not protected following the stress associated with their shipment to quarantine in the United States. In 1961, a new strain of killed Newcastle vaccine, developed at the Beltsville Research Center, U.S.D.A. was tested on francolins and found to be extremely effective in preventing this disease.

Fungus -- Aspergillosis is probably endemic in francolins in India. Both the black and the gray francolins proved to be rather resistant to this fungus in captivity as they are also to thrush (Candidiosis) according to experience at the Prattville State Game Farm in Alabama.

Internal parasites

Nematodes -- Heterakis, a caecal worm, was found in a number of wild francolins.

Ascaridia, round worms of several kinds, were found in about 10 percent of the birds examined. They were easily eliminated.

Capillaria, cropworms, were present in about 80 percent of the birds examined during our first year in India. By the third year the incidence of these parasites had dropped to about 25 percent.

A proventricular nematode, not identified with certainty, was found in about 10 percent of the black francolins autopsied.

The gizzard was apparently free of parasites.

An eyeworm, of the genus Oxyuris^(a), was located during the final year of the study in five black francolins. Eyeworms of the genus Oxyuris are rather common among Indian birds, having been recovered from 13 different species (47).

Heartworms were less common in black than in gray francolins. The species was identified by pathologists at Rutgers University as Paronchocerca rousselotti. This parasite was recognized early in our work in India and all birds received were subsequently tested for heartworms by a microscopic examination of blood smears for the living microfilaria of heartworms. Infected birds were eliminated from our flocks. Of 3,403 black francolins thus examined, 4.3 percent of the males and 4.0 of the females were found to harbor this parasite.

(a) Identified by Katherine Prestwood, University of Georgia.

The only noticeable physical effect of heartworms on the birds was that heavily infected individuals appeared to tire more quickly in flight. Upon autopsy usually only a few worms would be found in the heart though in one case 21 adult heartworms were removed from one bird. These worms are threadlike, the female being about an inch and the male about 3/4 of an inch in length.

Cestodes -- Tapeworms of several kinds were present, though not common, in the francolin autopsied. Cestodes, collected from black francolins in West Pakistan included Raillietina sp., and Choanotaenia sp. (a).

External parasites

Mallophaga -- Lice were fairly common on wild-trapped birds. All birds were dusted twice before shipment.

Arachnida -- Ticks (blue bug) were found on the head of a single black francolin from Sind, West Pakistan.

Red mites were occasionally observed.

Feather mites were encountered only once from birds gathered in West Pakistan.

Air sac mites were rather uncommon.

Diptera -- Louse-fly, apparently rare, since only one individual was located in examining many thousands of francolins.

The list of diseases and parasites given here is larger and more detailed than in previous reports. This is not because these birds are more subject to them than are other game birds, but rather reflects the increasing attention being given by Program biologists to this subject. In practice, under the Program, all wild-trapped birds are quarantined for at least two months in the country of origin before shipment to a second quarantine in the United States. During this time, it has proven to be possible to eliminate almost all of the diseases and parasites here mentioned by proper management supplemented by the use of vaccines, antibiotics and specific drugs.

Analysis of Competing Interests

Relation to Agriculture

Nowhere, either in reviewing the literature or in our contacts with men who till the soil, has there been voiced a complaint against black francolins. The grain that they eat is almost entirely waste and their

(a) Identified by Katherine Prestwood from specimens, poorly preserved in the field.

intake of weed seeds is high. In addition, they consume an unusually large proportion of insects. Mason (34) found that of 948 recognizable insects found in 30 black francolin crops, 6 were beneficial, 203 injurious and 739 neutral in importance to agriculture.

Usefulness

As a source of food -- The flesh of the black francolin is white and sweet, though rather dry and not particularly gamey in flavor. Few would consider it the equal of the bobwhite for there is a certain blandness and lack of strong flavor that creates partialities for the meat of certain kinds of game. Hume (26) considers francolins excellent table birds, especially roasted but only time will tell where they will stand in the hierarchy of American delicacies.

As a fighting bird -- Unlike the gray, the black francolin never impressed us as a pugnacious species. We have seen but few birds successfully caged for calling or fighting though Baker cites Pittman as indicating that they are occasionally trained for these purposes. In West Pakistan the trappers did catch some 500 males and a handful of females for us by enticing them within reach of handnets utilizing caged, calling males. In Bihar, India, these birds are also caught by the leg in an ingenious snare attached to a cage in which a male francolin has been confined.

As a game bird -- Throughout their range black francolins rate as excellent game birds. They lay well to a dog, rise quickly and fly straight and fairly fast. Where heavily pursued, however, birds soon learn to keep ahead of the hunter by running. The shooting is mostly singles or doubles, for they do not run in coveys except when driven to the edge of cover. Then 4 or 5 may rise individually in a matter of seconds. They are easy to bring down with $7\frac{1}{2}$ shot but very difficult to find when wounded. In India, possibly half of the birds put up and missed can be reflashed.

Where not too persistently hunted, large bags are not uncommon. In a four hour beat through tamarisk bottoms and cultivated fields adjacent to the Tigris River in Iraq, seven hunters flushed about 250 black francolins and brought 86 to bag. Near Delhi in India it was not unusual for eight beaters to put up 50 to 75 birds in a morning from which the normal bag for three hunters was 20 to 25 birds. In many coverts mixed bags of black and of gray francolins are the rule.

As a pet -- The black is much less commonly kept in cages than is the gray francolin. Baker says that, once caught, they tame rapidly and we have had half grown blacks that became fairly domestic but never one that, kept in a cage, could be given its freedom about the house and garden without fear that it would wander off. The striking coloration of the males, and the ease with which they can be kept in captivity recommends them to aviculturists for display purposes.

Relationship to Other Game Birds

Competition between different species, wherever their habitats overlap, is a law of life. Often, in birds, it manifests itself in their special requirements for territory, in their search for nesting sites and for food and water. Competition may be severe in one case and have but little effect in another.

Program biologists are alert to the possibilities of competition between foreign game species recommended for trial in the United States and native game birds. But, unless one actually makes a successful liberation of the new species in a fresh environment and analyzes the results, the only other source of reference is the study of the species considered for release in its native habitat.

With the black francolin, it has been possible to utilize both approaches. As a result of information already gathered, this species was recommended for limited trial in 1956 but it was 1960 before many birds were released. Since then, in several States and notably in Louisiana, the black francolin has demonstrated an ability to survive and reproduce in substantial numbers, mostly in croplands, grasslands and adjacent brush plots. In some areas the territory occupied overlaps that of the native bobwhite, thus providing alert State biologists with an opportunity to observe and evaluate any signs of competition.

The evidence thus gathered to date, indicates that the two species get along well together (46). The birds tend to separate into vegetationally different parts of the same area with francolins in soybeans, cotton, rice, and in tall, grassy and overgrown cover. The quail usually prefer overgrown fields and open woodlots. Thus, the two species are sometimes found in substantial numbers on the same 100 acre plot, but largely in different cover. Where their paths cross they appear to ignore each other or in winter to join forces in a loose covey of quail and francolins. On the Oak Ridge area in Louisiana, a male bobwhite and a francolin called, often simultaneously, for over a month from fenceposts 12 feet apart with no apparent antipathy. When flushed the bobwhite would fly to a brushy pasture, the francolin into a soybean field. Even though francolins are now said to be as abundant as quail on several trial release areas, no diminution in bobwhite numbers has been reported.

This apparently innocuous relationship was foreshadowed by our observations of francolins in their native habitats. Both the black and the gray francolins are commonly flushed from the same, often small, patch of sugarcane, wheat, millet, or mustard in northern India where ground cover is fairly open. In West Pakistan it was often impossible to predict which of the two species would be put up by beaters from the part cultivated, part overgrown flood plain of the Indus River. In Iraq along the little Zeb River, we flushed black francolins and seese partridges from the same patches of weeds and brush, lining the banks.



Figure 21. Both sexes are easy to maintain together in captivity.

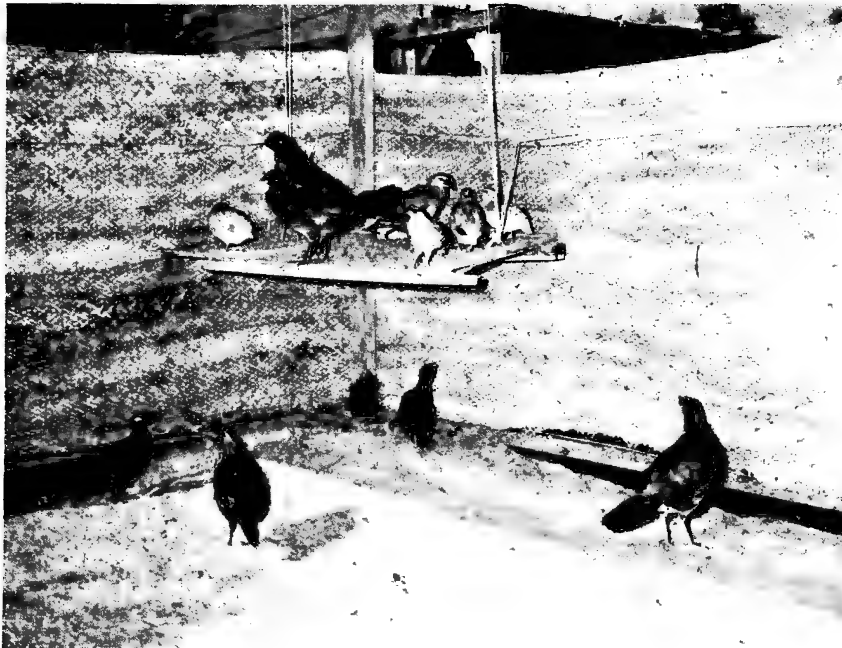


Figure 22. There was no problem in keeping small numbers of black and gray francolins, seesees and red junglefowl in the same pen.

In Corbett National Park, in the foothill valleys of the Himalayas, red junglefowl and black francolins commingled in brushy patches and along forest edges. Penned francolins in India were never seen to fight with other species of game birds with which they were experimentally confined, even during the breeding season. Nor were there other indications of incompatibility.

Breeding and Raising

Except with wild-trapped stock the black francolin is quite easy to breed and rear in captivity. Females caught in the wild usually do not produce many fertile eggs before their third year in captivity. First or second generation stock may be expected to produce from 15 to 25 eggs per laying female providing they are given plenty of cover in the pen and are not unduly disturbed. The record, to date, is an average of 31.4 eggs per female penned on the Virginia State game farm in 1962. The breeders and young may be handled much the same as wild-trapped bobwhites except that day-old chicks are much more nervous and subject to loss from fright. The major considerations, in propagating francolin may be summarized as follows:

Breeding -- Pair the breeders 1:1 to 1:3. Do not flock mate. Move them to breeding pens in late winter, Pens 4 x 8 x 6 to 9 x 12 x 6 feet work well as breeding pens providing there is plenty of low cover inside in which to hide. Where visitors are common, pens should be partially screened with burlap or canvas to keep the anxiety factor in females as low as possible. Provide food and water as for bobwhite quail.

Eggs -- In the southern States the period of egg laying in captivity normally extends from April through June. Eggs may be collected daily and stored, big end up, at 45 to 65° F for not over 10 days before incubation. Turn eggs at least twice a day.

Incubation -- As for bobwhite eggs. If placed in an agitated-air (fan type) incubator, they should be removed to a still-air (flat top) machine for hatching. Incubation period 19 to 20 days.

Brooding -- As for bobwhite except that greater care, not to frighten the young chicks, is advisable.

Rearing -- Young birds may be shifted from brooder to rearing pens at 5 to 6 weeks of age if desired. Handle as for bobwhite, pheasants or chukars.

Conditioning -- If birds are reared for trial liberation they should be conditioned for survival in the wild by first spending at least 3 to 4 weeks in a conditioning pen where they can fly readily and become acquainted to some extent with the general type of food and cover that they will encounter following release. Breeding pens 9 x 12 x 6 feet can be used for this but much larger covered pens are desirable. If the pen is covered with 3/4 to 1 inch mesh netting young birds may be liberated therein at 6 to 7 weeks of age without fear of escape through the mesh.



Figure 23. Net, rope, and basket for birds are standard equipment for a team of trappers.



Figure 24. The rope is used to scare the birds toward the net.



Figure 25. The net is set in or at the edge of the field.



Figure 26. The net is stretched from the ground over the top of the cover.



Figure 27. The rope is jerked slowly over the top of the cane.



Figure 28. The birds seek escape through the net which has been pulled down behind the beaters as they enter.

Liberation -- No clear agreement exists as to the best age for release. In current practice most birds are liberated any time from eight weeks of age onwards. Many game breeders prefer to overwinter flocks of birds in conditioning pens for early spring release. Late fall liberations should be avoided.

The propagation of black francolins, by States cooperating with the Bureau's Foreign Game Introduction Program, is briefly discussed in Special Scientific Report No. 80 (11).

Trapping and Banding

In many underdeveloped regions the country people have developed remarkably successful ways of trapping wild game. Guns are scarce, ammunition is costly, labor cheap, and food sufficiently scarce so that a ready sale for the catch is often assured. This has led in some cases to the development of trapping groups, tribes or castes, in others to accepting trapping as one of several means of livelihood. The methods used vary from group to group, some trappers becoming so specialized that they know how to catch only one or two species.

Where birds are for sale to Muslims, they are always taken alive. In southern Turkey black francolins are occasionally caught by hand as chicks. Large numbers of young birds, similarly captured, are sold in Iraqi bazaars during July and August. About Hillah, Iraq, adults are commonly taken in fall and winter by using orange-colored sheets. These are suspended over a small area, cleared in field or garden and baited with wheat, millet or date pulp. The francolins are reported not to be frightened of orange so at the proper time the sheet is dropped over the birds by a peasant operating a pull string from a blind. Some are also said to be picked up in hand nets by boys wearing orange clothing.

Along the Caspian littoral soft-mouthed dogs catch francolins that have been flushed once and subsequently seek escape by laying low. In West Pakistan one "tesildar" or large landowner provided us with some 500 black francolins caught in March by his tenants, using caged males as decoys to call the birds within reach of hand nets. Unfortunately almost all of the birds caught proved also to be males. Trappers about Wur near Tatta, West Pakistan, built low fences of brush and weeds, placed horsehair snares set in wooden frames in convenient openings therein, then drove the birds to the fence by beating adjacent cover. The francolins were caught by the neck but as soon as they stopped struggling the snare loosened up sufficiently to permit them to breathe.

In India, francolins were usually taken in nets often 50 to 100 feet long and 12 to 15 feet wide. Fairly heavy cotton cord was used to make these, and the mesh was commonly from 1 to 1½ inches to a side. Nets were staked out in or along one edge of a small field of sugarcane, grain, or a patch of weeds and brush and drawn up and over the top of the vegetation to a distance of 6 to 10 feet. Beaters then entered the field at the far side and slowly drove the birds into the net. In crops

it was even more common to pull a heavy 1/2 inch rope through the top of the grain or cane with enough speed to make the birds walk ahead and into the net without flying. Once birds were in the net the long edge over the top of the vegetation was pulled quickly to the ground to prevent their easy escape. Where francolins were common four trappers would often come up with a bag of 3 to 15 birds for about 5 hours of work. Trapping hours, using this method were from 6 to 10 in the morning and 4 to 6 in the afternoon with fewer birds caught near the middle of the day.

For banding adult black francolins, size 4 has proven satisfactory.



Figure 29. The legends of the desert are legion and happy are the men who tell them.



Figure 30. The ringing call of the gray francolin, once heard, is never forgotten

THE GRAY FRANCOLINS

The black and the gray francolins are presented in the same report for several reasons. Both inhabit southern Asia. Species ranges and the territory occupied by individual birds often overlap. Taxonomically, though not in appearance, they are closely related. Both are easy to raise in captivity and Foreign Game Introduction Program biologists had the opportunity to study them collectively as well as individually.

Several major differences exist between these species. One is their relation to water. The gray is predominantly a semi-desert or arid-land francolin, found where yearly precipitation averages from 3 to about 40 inches and the vegetation is inclined to be scattered or sparse. Yet it is adaptable to the somewhat thicker cover characteristic of grain, cotton or sugarcane fields as well as to scattered clumps of thick brush. The black francolin, on the other hand, is more at home in the denser vegetation associated with higher rainfall or, in semi-arid areas, in the brush, grass, weeds and cultivation common to watercourses and low-lying lands.

In overall distribution the gray is less widespread than the black francolin, but within its range it favors a much wider variety of dry, arid to semi-moist habitats. It can maintain itself for long periods on the water available as dew or from not too succulent vegetation. Food-wise it is a much better scrounger than the black, and more independent of insects and cultivated crops. Summer temperatures within some parts of its range reach 120°F for several days though the average maximums are, of course, considerably lower. Likewise fairly warm winters are the rule with much below freezing temperatures seldom recorded. Yet introduced adults have survived -12°F on several occasions in the Mason Valley trial release area in Nevada (12).

Of all those studied to date by Foreign Game Introduction Program biologists the gray francolin appears to be the species most likely to be adaptable to the semi-arid range and cultivated lands of the southwestern United States.

Taxonomy and Distribution

Whereas the black francolins extend in range from Cyprus to Assam, the gray are found mainly from southern Iran to east-central India and south to northwestern Ceylon. It is an interesting question why they have never colonized the extensive desert of the Middle East as have the black francolins in suitable habitats.

One species, Francolinus pondicerianus, divided into three subspecies, is recognized (6 and 42). These, together with their ranges, are detailed on page 3 of this report. Less speciation is to be expected among gray francolins since they are birds of rather generalized and continuous dry habitats.

Introductions

Successful introductions of gray francolins, together with those of black francolins are discussed on page 3 of this report.

Common Names

Fewer common names have been applied to the gray francolins than to the black. Those in common usage include the following:

Grey partridge	English (India)
Grey francolin	English (India)
Gray francolin	English (U.S.A.)
Common partridge	General
Titur	Urdu, Hindi (Pakistan, India)
Ram titur	Hindi (India)
Gora titur	Hindi (India)
Safed titur	Hindi (India)
Khyr	Bengali (India)
Karuthari	Maduri (India)
Tauzuari	Pushtu (Afghanistan)
Jirufti	Iranian and Punjabi

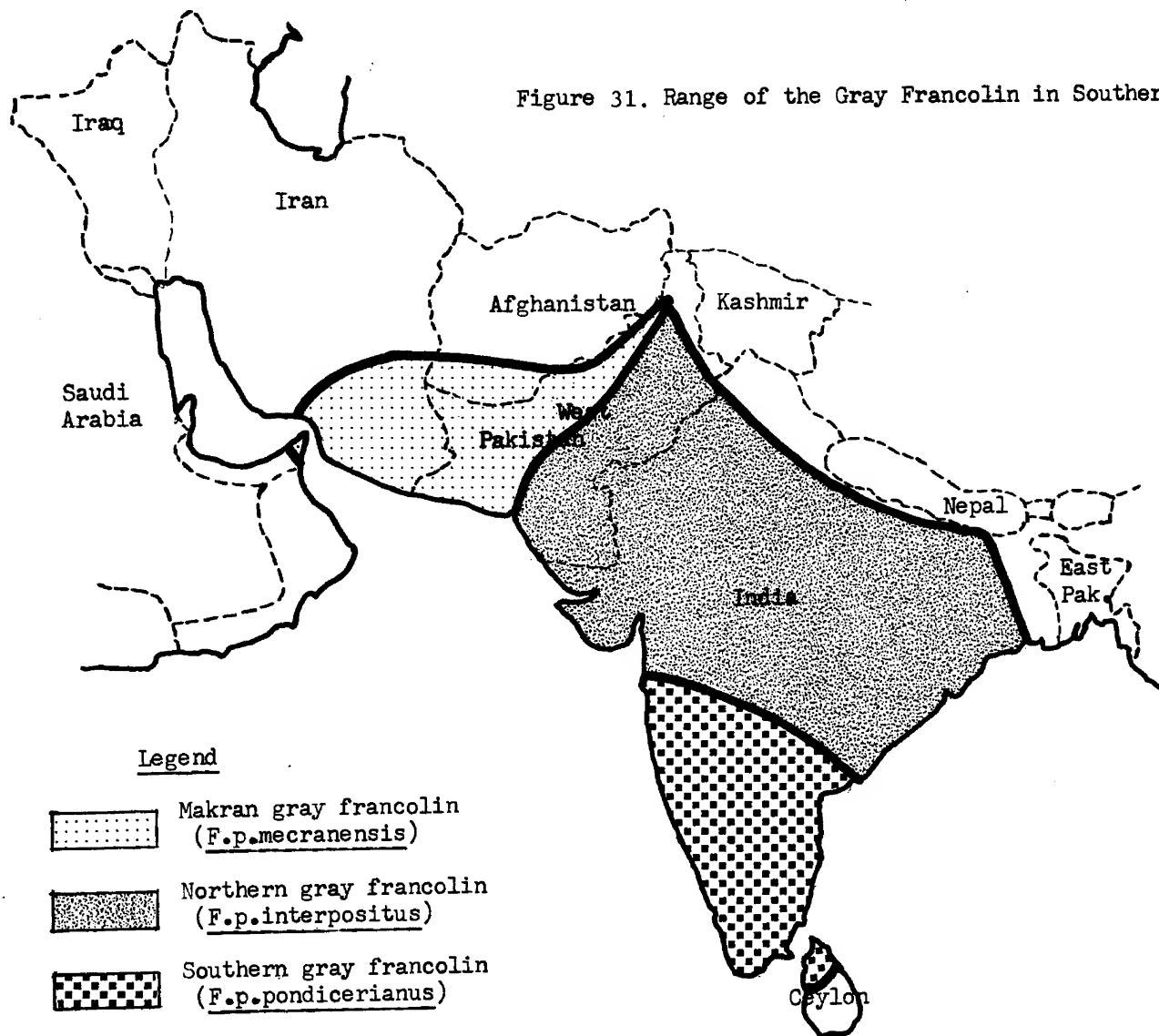
Titur, after the clear ringing call, is by far the most commonly used name in the Indian subcontinent.

Distribution and Abundance

Of the three subspecies of gray francolins, the Makran gray (F.p. mecranensis), ranging through southeastern Iran to the hills west of the Indus River in West Pakistan, is the most limited in range and abundance (6 and 42). To the east, through India, south of the Himalayas, to Poona, the Godavary River and Bihar, the northern gray francolin (F.p. interpositus) is found in favorable coverts, often in great abundance. South of the range of the northern gray, to northwestern Ceylon, the southern gray francolin (F.p. pondicerianus) is common. Considerations of climate, habitat and abundance combined to focus the attention of Foreign Game Introduction Program biologists on the northern subspecies.

Over most of the range of the gray francolins they are by far the most common resident game bird. In 1880, Hume (26) wrote, "...a man walking 10 miles through the desert (no water but heavy dew) may shoot 10 to 15 birds; around cultivated fields one might shoot 100 in the same distance." We found this still to be true in many parts of India and West Pakistan. This francolin's adaptability to habitat which is unfavorable for most other game birds, its keenness in meeting adversity and its high reproductive potential explains its ability to still maintain good to fair numbers even in the face of oppressive pressure from hunters,

Figure 31. Range of the Gray Francolin in Southern Asia.



trappers and the encroachments of civilization. We occasionally saw these birds scurrying through the shrubbery, or heard their very loud, lilting call, in many an Indian and Pakistani city. Malcolm MacDonald (31), British Ambassador to India in the late 1950's, observed gray francolins nesting in his 3-acre garden in the heart of New Delhi. They were still so abundant in 1961-62 that our chief trapper reported from 500 to 1000 birds a week were being sold, illegally, in the bazaars of New Delhi during fall and winter months. In our experience there are still not many areas in Pakistan or India where favorable habitat is without its complement of gray francolins in spite of more or less constant harassment from hunters and trappers.

Description

Field Identification

The gray francolins are distinctive partridge-like birds almost twice the size of the Gambel's quail. The general color is brownish, the breast buff, prominently barred with black; back chestnut and brown barred with buff; outer tail feathers chestnut. There is a distinct gorget line around the rufous or whitish throat. Sexes are alike except for long, sharp spurs on the males.

Key to Subspecies

Baker (6) gives the following key to the subspecies of the gray francolin:

- A. Darker; center of throat ochraceous - F.p. pondicerianus
- B. Paler; center of throat creamy-white - F.p. interpositus
- C. Palest; plumage generally more gray and less chestnut -
F.p. mecranensis

Coloration of northern gray francolin (F.p. interpositus)

The description of the northern gray francolin as given by Baker (6) and modified by our inspection of several thousand birds, wild-trapped in northern and western India, is as follows:

Male -- Forehead and supercilium pale rufous, the latter paler; crown and nape brown. Sides of head pale rufous, speckled with black on the lores, upper cheek, and behind the eye. Chin and throat creamy white surrounded with a prominent black transverse line on the foreneck and upper breast. Upper plumage pale grayish-brown mixed with pale buff and with pale fulvous cross bars, edged with black. The back, scapulars and wing coverts much mixed with chestnut. Primaries brown with indistinct white spots near the tip of the outer webs developing into bars on the outer secondaries. Inner secondaries with much black on the inner webs; the tips mottled with brown and fulvous. Upper tail coverts and rump vermiculated with indistinct dark bars. Inner tail coverts, scapulars

and inner secondaries white-shafted. Tail feathers 14. Central tail feathers like upper tail coverts; outer tail feathers light chestnut grading into broad, black subterminal bars, tips pale gray. Breast and flanks pale ochraceous-rufous, broken with black transverse bars; some chestnut diffused over upper breast.

Iris hazel brown, bill dusky plumbeous, paler and fleshy at the base; legs buff gray, each with one long (up to $3/4$ of an inch), very sharp, metatarsal spur. Double spurs, one above the other on one or both legs, occasionally occur. On young males "nubbin" spurs can usually be found at 6 to 8 weeks of age.

Female -- Similar to the male but usually without spurs.

Young -- At $2\frac{1}{2}$ to 3 months of age the young closely resemble adult birds except in size. Small, blunt spurs are normally present on young males at this time.

Crossbreeds

Crosses between the northern gray and the Makran gray francolin were common among the birds trapped in the lower Indus valley and are reported to occur where the ranges of the two subspecies overlap.

Size and Weight

The gray francolins are somewhat longer and more solidly built than the eastern bobwhite. Hume (26) gives the length of an adult male as 11.6 to 13.4 inches; the weight as 9 to 12 oz. Females are described as weighing 7 to 11 oz., with a length of 10.2 to 11.9 inches.

Netted east of Delhi, early in April, and weighed three days after trapping, 114 males averaged 9.68 oz.; 91 females 8.04 oz. in weight. It would not be uncommon for these birds to lose up to 2 ounces each, due to the strain of netting and penning, but to gain this back before shipment to the States.

In southern India, about Hyderabad, there is a strain of substantially larger gray francolin which is commonly known as "Hyderabad partridges." These birds are much prized over India and Pakistan as fighters and are commonly trapped and tamed for this purpose. We kept such a male until he died at 7 years of age. He was at least a quarter larger and 3 ounces heavier than any of the males trapped in northern India.

The Makran gray is recognizably smaller than the northern gray francolin.

Habitat and Cover Preferences

Cover

Gray francolins are adaptable to the widest variety of habitats of any game bird on the Indian subcontinent. Except for dense forests, swampy ground, bare, treeless or shrubless deserts and steep terrain, they utilize about every other type of cover providing some food and a source of water, often dew, is available. Humid tracts are also avoided.

Ali (3) indicates that they inhabit dry, open grass and thorn-scrub country interspersed with cultivation. Other authors describe suitable habitat as grazing lands with patches of second-growth deciduous shrubs; open, cultivated areas of the dry zone and adjacent patches of wasteland overgrown with thin shrub; open forests, and dense growths of shrubs such as Vitex negundo adjacent to fields of millet. Hume (25) writes, "I have shot them in the most desolate spots near the base of the hills in Sind, West Pakistan and on the Mekran Coast, Pakistan, Baluchistan, where there were no traces of vegetation at the time, and where, in the best season only a few straggling tufts of grass and (other) desert plants are to be seen." Birds, here, could not have been very abundant. We found them occasionally under similar conditions particularly if there was a scattering of trees or shrubs in which to roost at night.

In the arid to semi-arid tracts of the Sind or Thar desert of eastern West Pakistan, where rainfall averages 3 to 8 inches a year and irrigated fields are the rule, gray francolins were often abundant. Here cover consisted of little save a few weeds and grass in predominantly bare spaces between clumps of a desert shrub, Capparis aphylla, on the fruits of which they fed and between which they scurried when pursued. Other common species of the sparse, dry desert scrub areas were Prosopis specigera, Calotropis gigantea, Salvadora aleoides, Salsola sp., Suaeda and Haloxylon griffithii.

From further east in Rajasthan, India, where precipitation is from 8 to 14 inches a year, Christensen (12) provides the following, excellent description of vegetation:

"In the areas surrounding Jodhpur, Pokaran, and Bikaner, where the gray francolin and common sandgrouse trapping operations were carried out, the vegetational make-up of the habitat is dominated by an overstory of scattered mesquite (Prosopis specigera) with an understory of large spiny shrubs of which the principal ones are Capparis aphylla, Zizyphus, sp., Acacia leucophloea, Rhus mysorensis, and Euphorbia royleana. Along the roadways and in favorable low areas near the larger cities, the introduced honey mesquite (Prosopis juliflora) thrives, and in saline depressions species of tamarisk and other halophytes flourish. There are frequent expanses of bare ground, but during years of good precipitation the "desert floor" is covered with a turf of grasses and forbs. The forbs provide the major seed crop for the common sandgrouse and, to a lesser extent, the gray francolin. Some of the most common and prominent forbs are Calotropis sp., Aeura javanica, Indigofera sp., and Tephrosia sp. According to Sarup (44) and Sharma (45), there are at least 15 species of Cruciferae, 13 species of Capparidaceae, 45 species of Leguminosae, 16 species of Boraginaceae, 19 species of Solanaceae, and 49 species of Compositae. Grasses are very well represented with at least 88 species described from the area surrounding Jodhpur. Some of the most common ones are Elionurus hirsutus, Cenchrus sp., Heteropogon contortus, Gracilea royleana, Eragrostis major, Aristida sp., Cynodon dactylon and Sporobolus pallidus. Checkerboarding this vast desert region are small patches of cultivation which depend almost entirely upon the monsoon rains for success. The principal crops are millet (Pennisetum typhoideum)

sorghum (Sorghum sp.), pulse (Phaseolus sp.) and wheat (Triticum sp.). Toward the western reaches of the desert, near Jaisalmer, where the annual rainfall becomes less reliable and drops to below six or seven inches per year, the amount of cultivation is reduced drastically."

Within the area described, Christensen found gray francolins in great abundance in "the brush, fencerows, and hedgerows between fields and similar sites where there is good cover in the vicinity of cultivated fields. The predominant cover plants are Ziziphys sp., Capparis aphylla, Calotropis gigantea, Acacia sp., and Prosopis specigera. Grey francolins do tolerate the arid wasteland but they are not found in these drier, uncultivated tracts in any great numbers. The birds are frequently found in fields where such crops as millet, sorghum, wheat and pulse, in conjunction with native grasses and weeds, are present." Similarly, on the dry Indus plains of West Pakistan, gray francolins were abundant mainly in, or about, irrigated fields or where there was some dry farming.

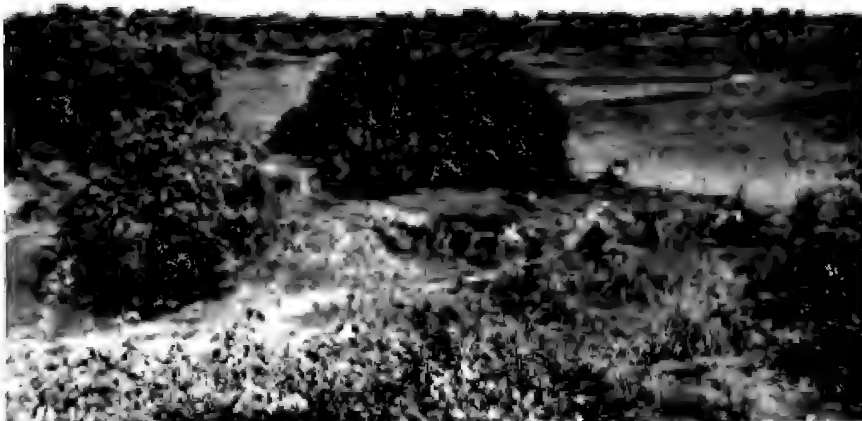
Gray francolins are by no means limited to semi-arid regions, provided that the cover is open in character. In India and West Pakistan where precipitation is recorded as from 15 to 20 inches annually, these birds are often resident in great numbers. The largely seasonal character of the rainfall, combined with the extensive distribution of saline or alkaline soils encourages the growth of largely xerophytic vegetation on uplands and in alkaline situations. Elsewhere, especially adjacent to cultivation, a mixture of arid and mesophytic plants is the rule. Crops commonly grown include bajra or Indian millet (Pennisetum sp.), jowar or sorghum (Sorghum sp.), wheat (Triticum sp.) mustard (Brassica sp.), pulse (Phaseolus sp.), sugarcane (Saccharum sp.) and cotton (Grassypium sp.) with occasional fields of corn (Zea mays).

The general pattern of cultivation is one of small fields, often combined to form extensive areas of intensive though rather primitive cultivation. Where there are breaks in topography, and soils are strongly alkaline or stony, or where the scrub has not yet been cleared, shrubs, forbs, weeds and grass occur, interspersed with patches of bare ground. Except in the forested areas and in the jungles of tamarisk and tall grasses adjacent to water, the general pattern of vegetation is so open and scattered that francolins can run freely and swiftly from clump to clump. When cultivation is extensive, and other shelter in short supply, these birds commonly utilize sugarcane fields as resting and escape cover. Several authors indicate that these francolins do not frequent grain fields until after they are cut. This is in error for we flushed many birds from such fields, irrespective of the stages of development, so long as they were not too dense.

The density of francolin populations is commonly a bird to 2 or 3 acres. Still higher numbers are occasionally found in particularly favorable situations. In numerous places, even within 60 miles of New Delhi, it was normal for 6 to 8 beaters to flush 75 to 100 birds in about 4 hours of hunting. In 1962, a group of 6 hunters killed 136 gray francolins in 6 hours with the aid of 12 beaters in the Gurgaoan district of northern India.



Figures 32-34.
Where it is
arid the cover
for gray
francolin is
often scanty.





Figures 35-37.
Even with more
rainfall the
cover is still
fairly open
in character.





Figure 38. Typical gray francolin cover about New Delhi.



Figure 39. Our trappers often found grays in fields of wheat.



Figure 40. Sugarcane, edged by fairly open ground, held many grays.

Out from the foothills of the Himalayas and in Bihar we also encountered a fair number of gray francolins in open forest cover, mainly second-growth. In the Palamau forest of western Bihar, we observed a family party of these birds along a forest road several miles from the nearest opening or cultivated patch.

Topography and Elevation

These birds are particularly common in flat to rolling country which is moderately to intensively cultivated, but broken up at frequent intervals by ditches, stony outcrops, stabilized sand-dunes, eroded lands or dry streambanks called nullahs. They will inhabit small slopes but avoid steep hillsides even though the latter are covered with light scrub growth.

Regarding elevation, gray francolins are very common in the Indus Valley, near sea level, and fairly frequent along the flanks of the foothills of the Northwest Frontier at 1,000 to 2,000 feet. We even trapped a few groups where our altimeter registered 4,600 feet in the Fort Sanderman district of the Northwest Frontier. They are also reported near Simla and in the Khangra Valley in northern India up to 4,000 feet. They are not hill birds, however, for the vast majority are located in flat to rolling habitat at less than 2,000 feet.

Soils

As with the black francolins the grays are resident on the entire range of soils described on page 16. Their distribution does not seem to be limited by the presence or absence of available calcium though the sandy loams, common to many semi-desert ranges in West Pakistan and western India, are high in pH. These birds also are abundant on the often acid forest and hill soils that extend southward from the foothills of the Himalayas well out into the plains. Nor, if food and cover are adequate, do they hesitate to utilize even the more bleak saline and alkaline soil types that are common throughout most of their range.

Climate

The principal climatic characteristics of gray francolin range are warmth and dryness. Hot summers, mild winters with no snow and at least 3 to 6 months of the year with little or no rain but with considerable dew, are normal conditions favorable to this species. Yet, in western Nevada, gray francolins, experimentally released in 1961, survived and bred following an abnormal winter in which temperatures receded to -12°F and snow was occasional for short periods (12). Situations such as this make wildlife biologists conscious of the limits of their knowledge and of the necessity of recommending empirical releases of some game birds in the absence of more definitive measurements of species adaptability to climatic factors.

Amount of Precipitation

Precipitation within the range of the species can be indicated only in general terms. Even at points, closely situated and at about the same elevation, substantial differences often occur (16). For many areas in southern Asia, weather records are inaccurate or nonexistent. Considerable time has been expended on the selection of 30 stations, widely scattered over the entire range of the gray francolin, as the basis for an analysis of monthly temperatures and precipitation (23 and 33). Yearly rainfall recorded varied from 2.0 to 58.1 inches per year; monthly, from 0.0 to 19.4 inches. Dry periods were the rule. At 2 stations no rain was recorded for 7 months. At 18 stations, there were 7 months or more in which rain was 0.5 inches or less. On the wetter side 9 stations recorded 1.0 inch, or more, for each of 6 months of the year, and at 9 stations, rainfall exceeded 3.0 inches for 4 to 5 consecutive months. Precipitation was excessive at 4 stations, at which over 10 inches of rain per month was recorded for 2 consecutive months. On the basis of annual precipitation the situation is as follows:

<u>Number of Stations</u>	<u>Average annual precipitation in inches</u>
7	below 5.0
7	5.0 to 10.0
4	10.1 to 15.0
1	15.1 to 20.0
5	20.1 to 30.0
2	30.1 to 40.0
4	over 40.1

So long as the general vegetative pattern is dry in character, gray francolins will withstand extreme variations in rainfall without noticeable difficulty. For example, at 2 stations there were 7 consecutive months without rain; and 3 others, monsoon deluges brought the averages for 3 consecutive months up to 35.4, 47.1 and 51.8 inches respectively.

Patterns of precipitation

The overall pattern of precipitation, with a few exceptions, is one of long periods of scanty rainfall interrupted by 3 to 4 months of moderate to heavy downpours. In general, the driest periods are March to April and November to December; the wettest are June through September. The following four patterns are evident:

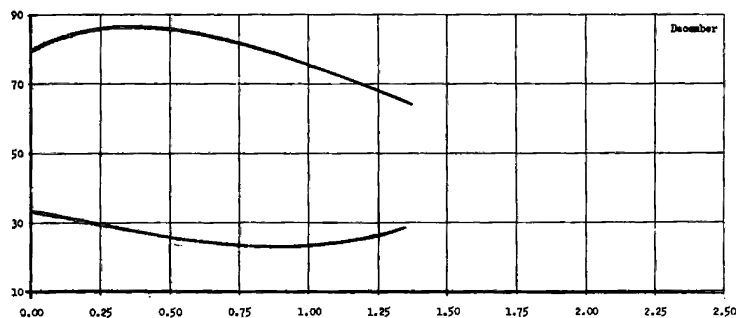
1. Light precipitation, mainly in winter and early spring. In amount this may vary from 1.3 to 4.7 inches for a three month period. The rest of the year is much drier. This pattern is characteristic of most of the range of the Makran gray francolin (F.p. mecranensis).

Table 4. Average Monthly Precipitation and Pattern at 30 Stations
Within the Range of the Gray Francolin

			Average Precipitation by Months												Av.
Pattern	Country	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	Afghanistan	Kandahar	3.1	1.7	0.8	0.3	0.2	0.1	0.1	0.1	0.0	0.1	0.1	0.1	7.0
	Iran	Seistan	0.5	0.4	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	2.1
		Zahidan	0.8	0.6	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.1	0.2	0.3	2.6
		Charbar	1.5	1.0	0.3	0.2	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.8	3.9
	Oman	Muscat	1.0	0.7	0.4	0.3	0.0	0.1	0.0	0.0	0.0	0.1	0.4	0.7	3.8
	Pakistan	Nok Kundi	0.9	0.4	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.0
		Panjur	0.8	1.0	0.6	0.4	0.1	0.1	0.8	0.3	0.0	0.0	0.1	0.6	4.8
		Ormara	1.5	2.2	0.2	0.6	0.0	0.0	0.7	0.1	0.0	0.0	0.0	0.6	6.0
		Kalat	1.3	1.4	1.1	0.6	0.2	0.2	0.6	0.3	0.1	0.1	0.2	0.9	7.0
2	Pakistan	Peshawar	1.4	1.5	2.4	1.8	0.8	0.3	1.3	2.0	0.8	0.2	0.3	0.7	13.6
		Lahore	1.0	1.0	0.8	0.6	0.6	1.6	5.4	5.2	2.2	0.2	0.1	0.5	19.2
	India	New Delhi	1.0	0.8	0.5	0.3	0.5	3.0	7.0	7.2	4.8	0.4	0.1	0.4	26.2
		Lucknow	0.8	0.7	0.3	0.2	0.8	4.5	12.0	11.5	7.4	1.3	0.2	0.3	40.0
		Patna	0.6	0.7	0.4	0.3	1.4	7.1	11.6	13.0	8.6	2.3	0.3	0.2	49.7
		Jubblepore	0.8	0.8	0.6	0.3	0.6	7.0	19.4	17.0	8.4	1.9	0.4	0.4	55.4
		Sukkur	0.2	0.3	0.2	0.1	0.1	0.1	1.1	1.1	0.0	0.0	0.0	0.0	3.7
3	Pakistan	Bahawalpur	0.2	0.3	0.4	0.2	0.2	0.3	2.4	1.3	0.1	0.1	0.0	0.2	5.7
		Hyderabad	0.2	0.2	0.2	0.1	0.2	0.4	3.0	2.0	0.6	0.0	0.1	0.1	7.1
		Karachi	0.5	0.4	0.3	0.1	0.1	0.7	3.2	1.6	0.5	0.0	0.1	0.2	7.7
		Badin	0.2	0.4	0.1	0.0	0.2	0.7	4.0	2.3	0.9	0.0	0.2	0.1	9.1
		Bikaner	0.3	0.3	0.2	0.2	0.6	1.2	3.3	3.6	1.3	0.2	0.1	0.2	11.5
	India	Barmer	0.2	0.3	0.2	0.2	0.3	1.1	3.3	5.3	0.7	0.1	0.0	0.1	11.8
		Jodhpur	0.2	0.2	0.1	0.1	0.4	1.4	4.0	4.3	2.4	0.3	0.1	0.1	14.2
		Jaipur	0.4	0.3	0.3	0.2	0.6	2.2	7.7	8.1	3.2	0.5	0.1	0.3	23.9
		Poona	0.1	0.1	0.1	0.6	1.1	4.5	6.6	3.5	5.3	3.5	1.1	0.1	26.5
		Hyderabad	0.3	0.4	0.5	1.2	1.1	4.4	6.0	5.3	6.5	2.4	1.1	0.3	29.6
4	India	Bangalore	0.2	0.3	0.4	1.6	4.2	2.9	3.9	5.0	6.7	5.9	2.7	0.4	34.2
		Ludhiana	1.5	1.4	0.9	0.7	0.5	2.3	8.1	6.7	3.0	0.5	0.4	0.7	27.2
		Madras	1.4	0.4	0.3	0.6	1.0	1.9	3.6	4.6	4.7	12.0	14.0	5.4	49.9
		Ranchi	0.9	1.8	1.2	0.9	2.1	8.6	15.4	13.8	9.3	3.1	0.6	0.3	58.1

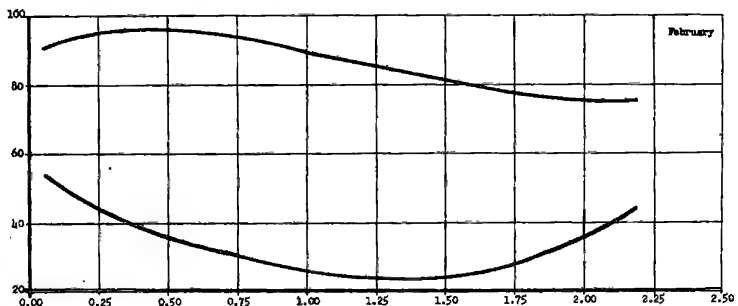
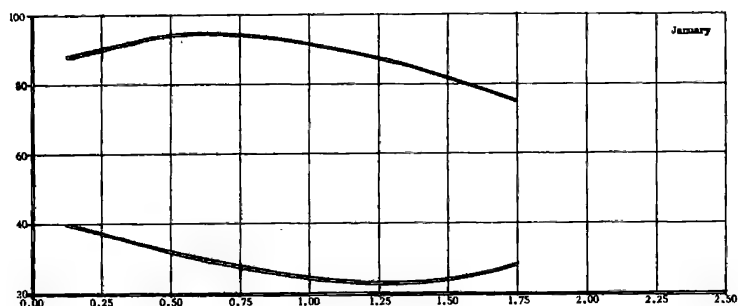
Figure 41. The range between the average of the maximum and of the minimum temperatures according to average precipitation, by months, within the distribution of Francolinus pondicerianus.

09
Temperature in degrees F.

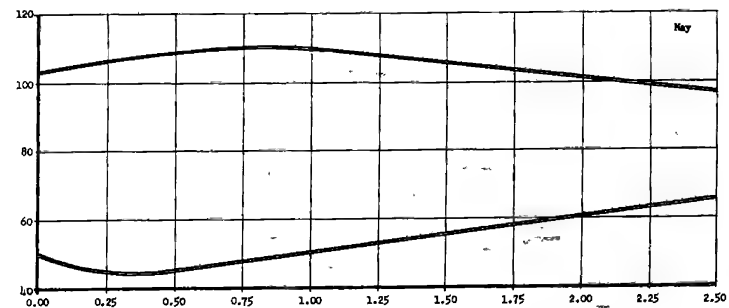
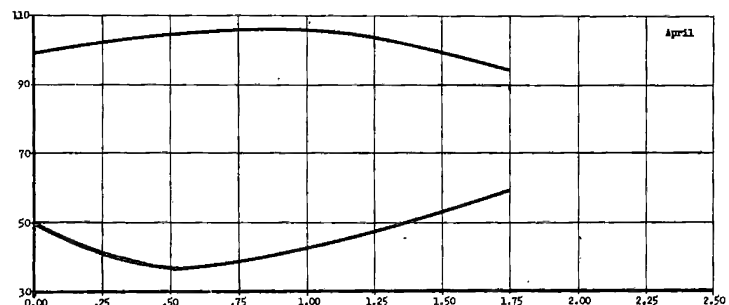
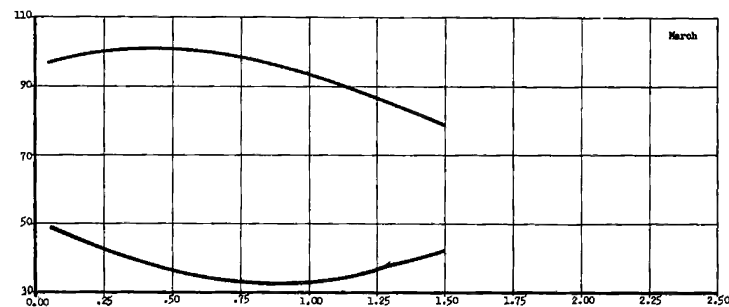


Average
maximum

Average
minimum



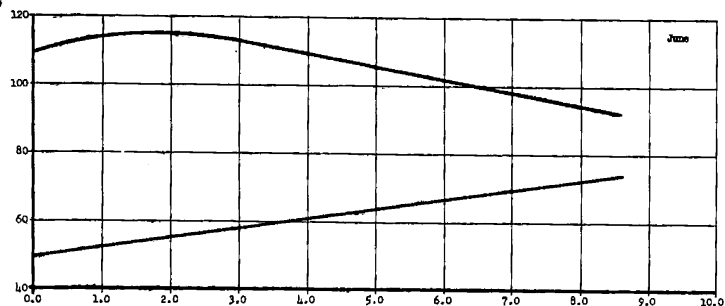
Precipitation in inches



Precipitation in inches

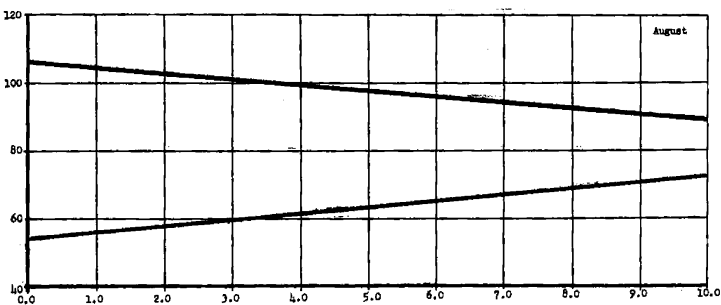
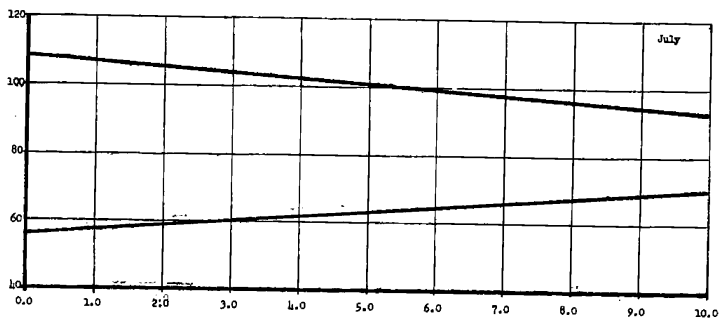
Figure 41. The range between the average of the maximum and of the minimum temperatures according to average precipitation, by months, within the distribution of *Francolinus pondicerianus* — (cont'd.)

19
Temperature in degrees F.

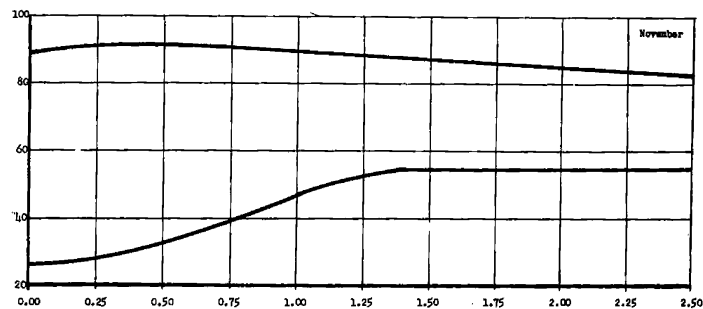
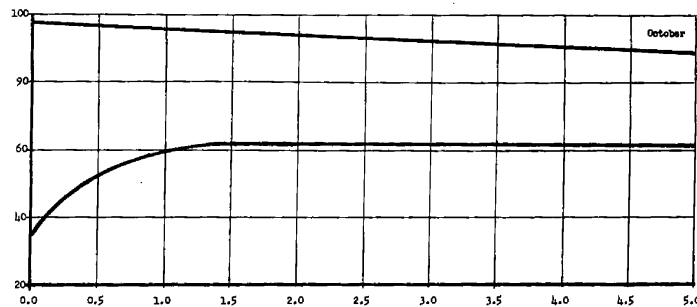
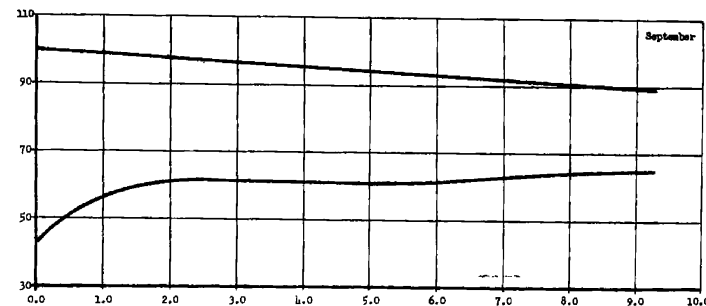


Average
maximum

Average
minimum



Precipitation in inches



Precipitation in inches

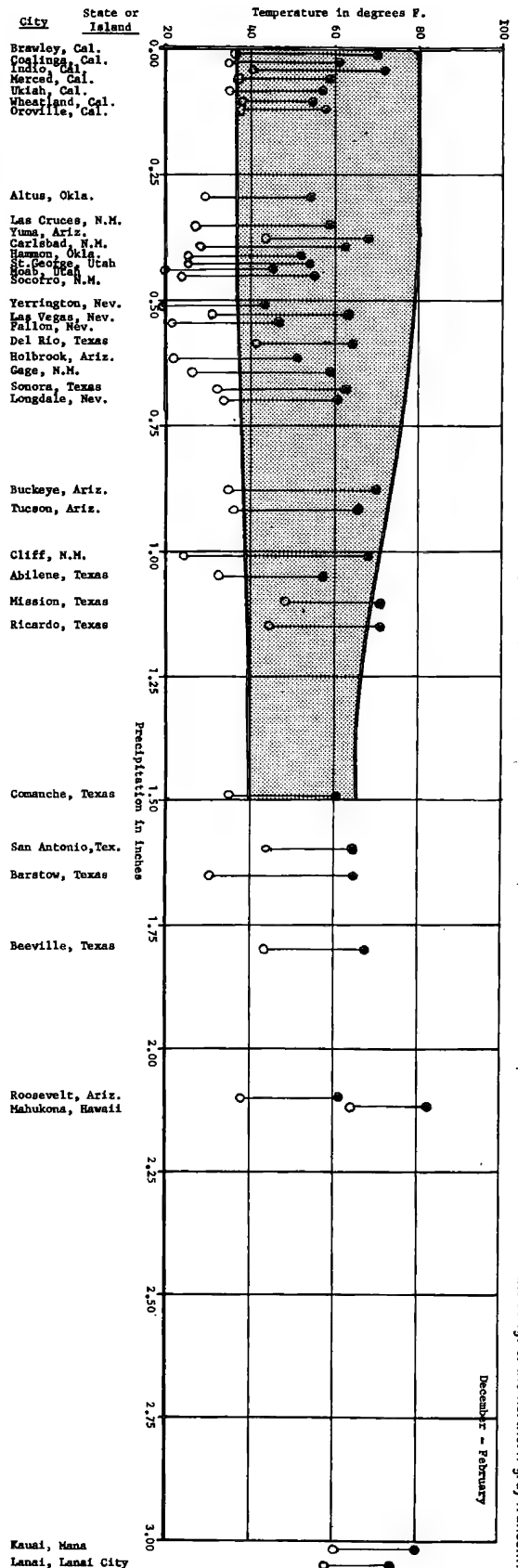
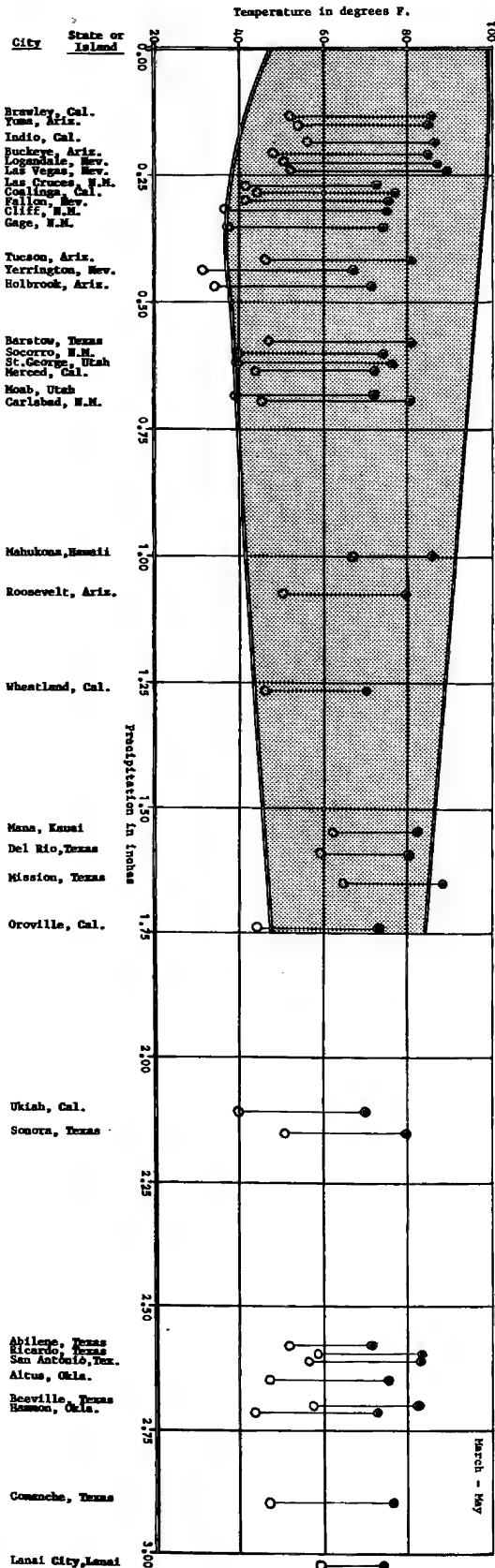
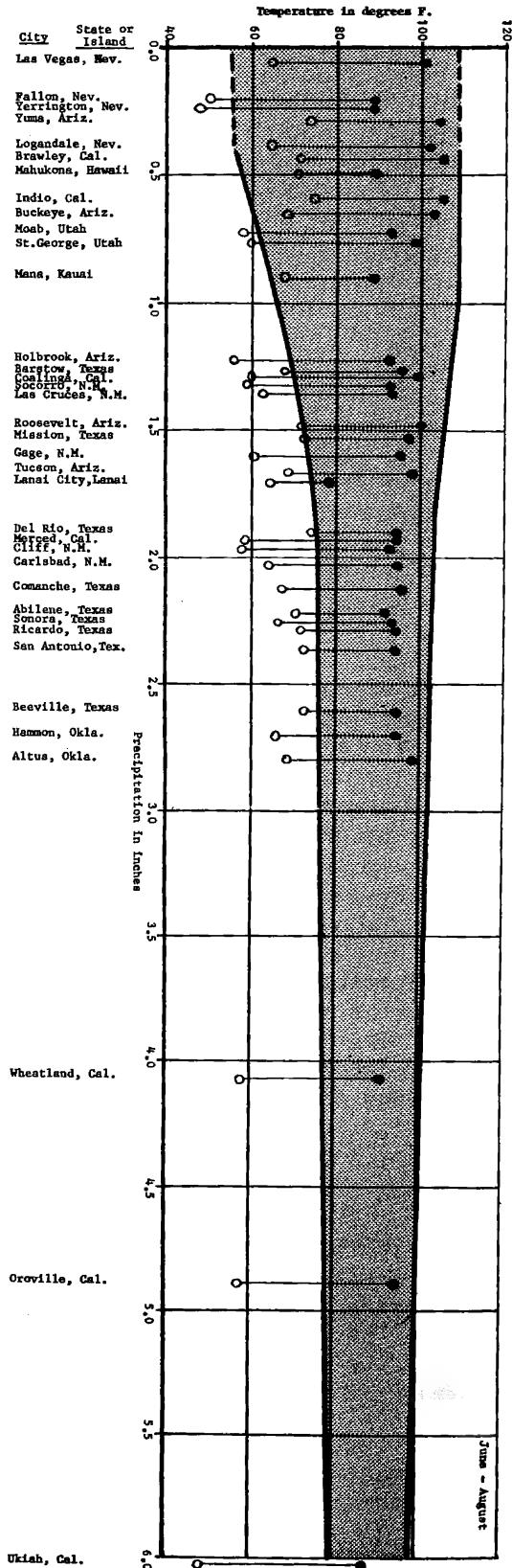
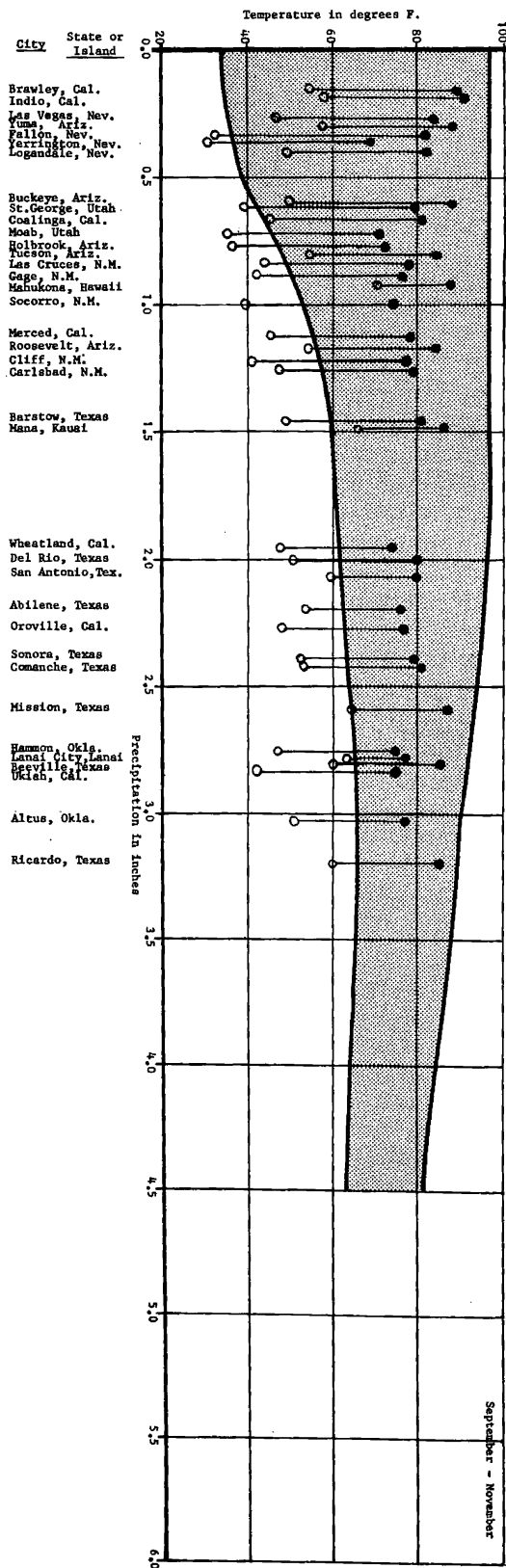


Figure 42. Average maximum and average minimum temperatures according to precipitation, by seasons, for stations in the United States compared with similar data from the range of the northern gray francolin.



2. Light precipitation in winter with considerably greater amounts in summer. This is the pattern over much of the productive range of the northern gray francolin (F.p. interpositus), in upper West Pakistan and northern India. It arises from a weak northeast monsoon in winter and a heavier southwest monsoon in summer. The northern gray francolin is often abundant where this pattern prevails.

3. Little rain throughout the year except in summer. In this pattern the northeast monsoon is largely lacking, but summer rainfall coming with the southwest monsoon is often considerable. This is the pattern in eastern West Pakistan, in Rajasthan in western India and in much of southern India. Mecranensis, interpositus and pondicerianus all thrive under this pattern of precipitation.

4. Fair to heavy precipitation throughout the year except for 1 to 3 dry months. This pattern, rather limited in extent, occurs in parts of East Punjab, western Bihar in northern India, and in Madras to the south. Interpositus is fairly common in these areas where the cover is not too dense.

A comparison of precipitation under these patterns is presented in Table 4.

Temperatures

Gray francolins seem impervious to summer heat. We have seen them near Hyderabad, West Pakistan, in sunny openings where the thermometer registered 120°F. It has climbed to 124°F. Average maximum summer temperatures in the more arid parts of their range are often above 110°F for extended periods yet francolins are also abundant where it is from 90° to 100°F. Minimum summer averages vary from 52° to 76°F, though they are somewhat higher in semi-desert areas.

Winter temperatures are also usually high, seldom dropping below freezing, though average minimums of 23°F in January are recorded for the uplands of Pakistan, Baluchistan and the Helmand valley of Afghanistan. Through northern India it is generally warmer, varying from 40° to 55°F. Frost is by no means uncommon but the ground is seldom frozen even to the depth of an inch in the coldest parts of its range. Snow is extremely rare. A detailed monthly analysis of temperatures in relation to precipitation is presented on pages 62 and 63. These climacurves, constructed as indicated on page 18, are based on records from 30 stations throughout the entire range of the gray francolin.

Comparison with stations in the United States

Only the northern gray francolin (F.p. interpositus) has been introduced in numbers into the United States. To compare temperatures and precipitation within the range of this subspecies with those in the States, climacurves based on records from 35 stations were constructed on a seasonal basis. Winter is represented by December through February, spring,

March through May, summer, June through August, and fall, September through November. The average maximum (black circles) and average minimum temperatures (white circles) in relation to precipitation for 34 stations in the southwestern United States were plotted on these summaries. These circles are connected with a black line for easy reference. The completed comparisons are presented in Figure 42 pages 62 and 63.

Average maximum and average minimum temperatures are generally low for many of the stations considered, except in spring. Only a few stations would seem to be so far out of line as to rule out the area surrounding them as potentially suitable for trial releases.

Food and Water

A delightful Indian proverb runs, "The gray francolin carries its food for its life in its beak" - meaning that it often frequents areas so dry that there appears to be no food there for it to eat. Even this challenging situation apparently did not stir either ornithologists, or bird lovers to investigate the matter further.

Previous to the food habits studies made by Program biologists in West Pakistan and India, no attempts to explore the food preferences of gray francolins, in any detail, are recorded. Husain and Bhalla (27) scanned the foods eaten by 60 birds collected near Lyallpur, West Pakistan, in 1926 and reported that grains, weed seeds, vegetable matter and insects such as locusts, black ants, termites, beetles and grubs, were commonly eaten. Ali (3) adds to this list the berries of Lantana. Other references in the literature are either still more general or limited to specific items that had attracted attention.

In 1956 and 1957 Faruqi and Bump (19) analyzed the crop contents from 16 gray francolins, collected from a semi-desert area near Tatta, West Pakistan. Some cultivated grains were raised here, partly on irrigated lands. Since reference collections of local seeds were unavailable considerable time was spent in the field identifying the plants from which the seeds came. Other seeds were planted in pots to permit recognition as the plants matured. Of the crops examined, 9 contained only vegetable material. Both plant and animal items were found in seven crops. In all, 22 species of plants were identified. Vegetable matter most commonly taken included common mustard (Brassica campestris), wild millet (Erichloa procera), jungle rice (Echinochloa colona), a cruciferae (Farsetia jackmontii), and a grass (Dactyloctenium scindicum). Only two seeds from cultivated crops were present. Animal matter included black ants, termites, beetles, spiders and snails.

In 1959 and 1960 Christensen (12), assisted by Indian botanists, completed an analysis of 38 gray francolin crops, collected near Jodhpur in the semi-arid portion of the Thar desert in western India. He reported that 20 species of plants, mostly in the form of seeds were eaten. Of these, 6 were cultivated plants and of the 12 others identified all were commonly associated with, or found near, cultivation. Most commonly taken were panic

grass (Panicum turgidum), millet (Pennisetum typhoidum) and sorghum (sorghum sp.). Insect material occurred in 24 of the 38 crops examined and represented 34.5 percent of all material eaten.

The need for additional definitive studies of francolin food habits from various parts of its range is evident, in that out of 28 genera of plants identified in the two studies, only three, Panicum, Sorghum and Triticum were common to both.

The data from both studies were combined and published in India in 1960 (Faruqi, et al. 20). To facilitate ready reference to this, the part referring to gray francolin is reproduced here.

"Like the black, the gray francolin is omnivorous. Of the crops examined 23 contained only plant material, one only insects, and in 30, both plant and animal items were found. From these, 33 species of plants and 7 orders of insects were identified. Miscellaneous items eaten included fragments of coal, baked bricks, grit, and snail shells. Animal material, other than insects, was limited to a few solifugids and spiders.

"A great variety of weed seeds with some cultivated grain made up the bulk of the plant food. Members of the grass family are also well represented. Seeds were the prominent form of the plant food eaten. The variety and quantity of food taken is surprising. For example, one crop collected in upper Sind on February 26 contained 1 wheat seed (Triticum vulgare), 1 seed of wild melon (Citrullus colocynthis), 1500 of Dactyloctenium scindicum, 2000 of jungle rice (Echinochloa colonum), 4 of Abutilon sp., 5 of cockscomb (Celosia sp.), 1 unidentified seed, 1 green leaf, 1 large black beetle, 1 small beetle, and 2 termites. Another crop collected in Rajasthan in July contained green blades, hundreds of termite larvae (white ants), 6 cutworms, 18 tenebrionids, 3 carabids, 8 hydrophilids, 3 weevils, and grit.

"Insect food was taken abundantly in the summer with gray francolins showing a high preference for ants and termites. Interestingly enough beetles, some of which were of large size, comprised a substantial portion of the diet. In winter, where mustard is available, it is a favorite food."

The analysis of foods eaten in summer, fall, and winter is presented in Table 5. No birds were collected in the short period represented by spring.

A few seemingly unusual items might be mentioned. Soman (48) found a partially digested snake (Boiga trigonata), 9 inches long, in a bird collected near Poona, India. Hume (26) indicates that cattle dung, as well as the grain present therein, is commonly consumed. Phythan-Adams (39) considered the gray francolin to be a "dirty eater" and recommends that crops be examined, when shot near villages, before cooking. Dunbar-Brander (17) writes that gray francolins "used to collect around famine camps and can often be seen around villages, busy with excreta." Yet among the several hundred grays shot in India and Pakistan we never located a gray with feces in its crop.

Table 5. Foods eaten by the gray francolin according to season and number of crops in which each was found

Foods		Parts Eaten	Season			
			Sp.	Su.	Fall	Wi.
Plant						
<u>Abutilon</u> sp.	Indian mallow	seeds	1			2
<u>Acacia</u> sp.		seeds	4			
<u>Brassica campestris</u>	mustard	flower buds				3
		flowers				2
		Pods				1
		seeds				2
		leaves				4
<u>Capparis aphylla</u>		seeds	9			4
<u>Celosia</u> sp.	cockscomb	seeds				4
<u>Cephalandra indica</u>	a cucurbit	fruit skin	1			
		seeds	1			
<u>Citrullus colocynthis</u>	wild watermelon	seeds	2			1
<u>Cyperus rotundus</u>	flat sedge	rhizome	1			
<u>Dactyloctenium aegyptium</u>	a grass	seeds	1			
<u>Dactyloctenium scindicum</u>	a grass	spikelets				1
		seeds	1			4
<u>Echinochloa colonum</u>	jungle rice	seeds	4			2
<u>Eragrostis minor</u>	a lovegrass	seeds		3		
<u>Eriochloa procera</u>	a wild millet	seeds	4			2
<u>Farsettia jacquemontii</u>	a cruciferae	flower buds				3
		Pods				4
		seeds	1			1
<u>Gynandropsis gynandra</u>		seeds	3			2
<u>Indigofera</u> sp.	indigo	seeds				2
<u>Lathyrus sativus</u>	wild pea	seeds				1
<u>Launaea nudicaulis</u>	a compositae	inflorescence				3
		leaves				1
<u>Mukia scabrella</u>	a cucurbit	fruit skin	2			
		seeds	2			
<u>Panicum antidotale</u>	panic grass	seeds	1			1
<u>Panicum turgidum</u>	panic grass	seeds	8	5		1
<u>Pennisetum typhoideum</u>	bajra, a millet	seeds	6			4
<u>Phaseolus aconitifolius</u>	pulse	seeds	1			3
<u>Phaseolus radiatus</u>	pulse	seeds				2
<u>Rhynchosia</u> sp.	a legume	seeds				1
<u>Scirpus</u> sp.	bullrush	rhizome	2			
<u>Setaria verticillata</u>	bristlegrass	seeds	1			
<u>Solanum nigrum</u>	black nightshade	fruit				1
<u>Sorghum</u> sp.	sorghum	seeds	4	3		1
<u>Tephrosia purpurea</u>	a legume	seeds				3
<u>Tribulus</u> sp.		seeds				1
<u>Triticum vulgare</u>	wheat	seeds	2			1
<u>Zizyphus</u> sp.	jujube	fruit	4			
Unidentified	grass	blades	8	3		1

Table 5. Foods eaten by the gray francolin according to season and number of crops in which each was found - (cont'd.)

<u>Foods</u>		<u>Parts Eaten</u>	<u>Season</u>			
			Sp.	Su.	Fall	Wi.
Animal						
Hymenoptera	ants	whole	10	1	5	
Isoptera	termites, adult					
	and larvae	whole	10		1	
Coleoptera	beetles	whole			3	
Scarabidae	a beetle	whole	4		2	
Tenebrionidae	a beetle	whole	5	1		
Hydrophyllidae	a beetle	whole	5	1		
Carabidae	a beetle	whole	5	1		
Elateridae	click beetles	whole	1			
Buprestidae	a beetle	whole	1			
Curculionidae	weevils	whole	4			
Lepidoptera						
Noctuidae	cutworms	whole	3	1		
Orthoptera	grasshoppers,					
	crickets	whole	2		1	
Homoptera	bugs	whole	2			
Diptera	flies	whole	1			
Solifugae		whole	2			
Araneae	spiders	whole	1			
Miscellaneous						
	grit	pieces	9	4	4	
	snail shells	whole	1			
		pieces				2
	coal	pieces				2
	baked brick	pieces				2

An interesting study of ten gray francolins, introduced into Nevada, and subsequently collected for food analysis, was carried out by Christensen and Alcorn (12) in 1960 to 1962. The following plants, listed as to frequency of occurrence, were identified:

Barley (<u>Hordeum vulgare</u>)	Alfalfa (<u>Medicago sativa</u>)
Barnyard grass (<u>Echinochloa crusgalli</u>)	Barnyard grass leaves and chaff
Barley chaff	Jackass clover (<u>Wislizenia refracta</u>)
Pigweed (<u>Chenopodium</u> sp.)	Johnson grass (<u>Sorghum halepense</u>)
Wheat (<u>Triticum aestivum</u>)	Grass leaves
Milo maize (<u>Sorghum vulgare</u>)	Sunflower (<u>Helianthus</u> sp.)

The availability of drinking water seems to be of but little concern to the gray francolin. Where dew or fairly succulent vegetation is available this species can subsist for long periods without taking a drink of water. As a test we once kept a captive gray francolin for two months on grain supplemented daily with a single leaf of lettuce the size of the palm of our hand. Occasionally the bird was also offered water to drink, which was generally refused. Interestingly it, and several others among our captive grays also refused bourbon and other liquors except scotch (the British influence?). Of this they would take 5 to 8 sips but never enough to exhibit the slightest untoward effect. In all our field studies of gray francolins throughout West Pakistan and India no birds were observed drinking. In fact it was not uncommon to see these birds several miles from the nearest known water even in the blistering heat of early summer. In captivity they consume substantially less water than do chukars or black francolins.

General Habits

Movements and Mobility

These francolins are nonmigratory and generally sedentary though they unquestionably move about the country for short distances in search of food. That they will travel far if the need arises, was demonstrated graphically when in 1956 the lower Indus river overflowed its banks, inundating our trapping sites and creating a flooded plain up to 50 miles wide. For a month little but trees, an occasional rise of land and a few irrigation banks were visible above the water. This forced both the resident black and the gray francolins to move distances up to 20 miles to find food and shelter. Yet, within three weeks of the abatement of the flood, both species were again observed in the usual numbers in many areas from which they had been driven.

While no birds were banded during the study in Pakistan or India, apparently resident populations were observed in several semi-isolated habitats less than 100 acres in extent. Numerous records in the literature attest to birds nesting, raising a brood and being frequently seen throughout the year in compounds or gardens, only a few acres in extent, within the limits of large cities.

Moslems in West Pakistan say that a gray francolin carries itself like a graceful woman. These birds are generally leisurely walkers until disturbed. Then they take wing or scurry from bush to bush, especially in desert areas, running fast but often pausing under one shelter before making a dash for the next. In fact one of our tame grays was so quick in movement that, given the run of the house, he made a sizeable dent in the fly population by catching flies, even on the wing.

Gray francolins move further than blacks when liberated in a new habitat. Millazzo (36) reports that of the 100 birds released in 1962 in Smith Valley, Nevada "one pair of birds had moved four miles from the release site by the third day, and during the following 26 days a total of 8 sightings (mostly pairs) had been made. The greatest movement within the 26 day period was about 6.5 airline miles with an average distance of 3.7 miles." Some of the grays liberated in 1960 in western Oklahoma were seen about 50 miles north of the release site several years later.

Daily Movement Pattern

These birds move from their roosts at dawn to fields, stubble, ploughed lands or any broken waste, or open pasture preferably where there are some shrubs, forbs, weeds and grass. They are also commonly seen along paths and roads picking up waste from passing animals. Sometimes they are reported as following the farmer scraping his fields with a steel-shod wooden plow. By the time the dew is dry many are headed for thicker resting places such as fields of cotton, wheat, maize, mustard or sugarcane. Others seek thick, brush clumps. Occasionally, though, one finds some birds still in the open under the broiling sun of midday. Early in the afternoon, when it is still hot, many return to the feeding areas though they are generally less active than in the morning. Before sunset they are again on their way to their favorite tree or bush to spend the night.

Flight

The flight is direct and quite fast. Hume (26) says that they rise with a true partridge whirr, that their flight is swifter and stronger than that of the Hungarian partridge in England; also that they will carry more shot. The grays often seek escape by running and hiding. When surprised or pressed, they may fly 200 to 500 feet before alighting unless in thick cover when their flight is much shorter. When reflushed, the distance covered is usually less than the first flight with the birds becoming increasingly difficult to locate. Normally they do much more walking than flying.

Wariness

As with black francolins, grays are not particularly wary birds unless harried or heavily hunted. They are often seen along the roads or heard calling close by as one tramps through the scrub. In sparse cover, or when chased, they are apt to start running while the pursuer is yet 100 to 200 feet distant. But in spring and summer, we have

followed family parties from one shrub clump to another, close enough to take movies, without the birds evidencing too much concern. In semi-arid Rajasthan, Christensen's trappers commonly herded groups of grays slowly from clump to clump and into their nets. Where much-hunted, however, many birds may sit tight, frequently taking flight from the other side of a bush, or running briefly and then becoming airborne well out of gunshot.

Roosting

Normally these birds prefer small trees or thick, often spiny, shrubs in which to roost. After some hesitation, they settle down on the smaller, lateral branches, often well out from the trunk. Near Karachi, Pythian-Adams (39) observed them roosting on milkweed fences thrown up along field borders.

Good gray francolin habitat usually is characterized by a scattering of trees or shrubs for roosting. Yet Humayan Abdulali (a) wrote us that "they also occur in semi-desert areas where there are almost no tall vegetation and where they, in all probability, roost on the ground. In Sind, West Pakistan, where large areas have but little vegetation except for occasional clumps of a low shrub (Capparis sp.) there is no doubt that they roost therein."

Nesting and Renesting

Gray francolins have the longest nesting season of any game bird with which we are acquainted. Hume (26) indicates that eggs have been found in every month of the year in India. Females, netted near Delhi, deposited eggs in our carrying boxes on February 18 and 19, 1959. Christensen (12) trapped youngsters not over three weeks old near Jodhpur as late as January 1, 1960. There was no month during our October to April trapping season in which young birds were not caught in Pakistan and in northern India. Christensen and many other writers believe that there are two main breeding seasons in India. One is from February to the beginning of the June monsoons, the other at their conclusion in September through November.

The nest is usually a slight depression in the ground casually lined with leaves and grass. It is often hidden under brush, slightly raised above the surrounding ground level, or on the banks of a nullah (dry stream) or a canal. Other locations may be alongside a clod of dirt or a tuft of grass. Hume often found the nests on quite bare ground.

For nesting cover Lowther (30) suggests that two types are favored. These are "irregular ravines neither narrow or too deep, studded with light to medium scrub jungle, or light scrub land often with babul trees (Acacia sp.) intervening and bordered by cultivation." Baker (6) considers the bottom of hedges or isolated clumps of cactus as favorite nesting sites. Ali (3) lists grasslands, plowed fields, standing crops and scrub jungle as likely locations.

(a) At the time, secretary of the Bombay Natural History Society.

Wayne Bohl, with the help of local villagers, located four gray francolin nests near Agra, India. All were ground nests except one. The first was in an orchard with low pasture growth beneath; the second on a ditch bank under acacia brush; the third in an old excavation filled with trees and brush surrounded by the baked earth of a cultivated field. The fourth, and most unusual nest, was about five feet from the ground on top of a stacked pile of sorghum. An inhabited house was about 20 yards from the nest. It was eventually deserted, quite possibly because of too much human visitation to inspect the progress of incubation.

One nest, which I observed near Karachi, was at the edge of a clump of grass near a cultivated field of bajra (millet). Though ground nesting is the rule, Finn (21) also recorded a nest in a tree about three feet above the sod.

It is not unusual to find nests in close association with human habitation, particularly in gardens, even in large cities. Edwards (18) writes of one behind a small hedge in the middle of old hedge cuttings, 15 yards from a picketing area for horses in the Delhi cantonment.

Renesting is normal with at least two and possibly even three broods reared in a single year.

Eggs

Generally 6 to 9 eggs are laid though in captivity the number is much larger. At the Texas State Quail Farm 60 breeders averaged 37 eggs each in 1963 (11). The eggs vary in shape from slightly elongated ovals, a good deal pointed at one end, to broad pegtops (6). Shells are fine and glossy-white, more or less tinged with cafe-au-lait color varying much in depth and intensity. Small, raised chalky patches, looking like drops of whitewash are not infrequent on the shells. Baker (16) found eggs to average 32.4 x 25.6 mm, which is not much smaller than the eggs of the black francolin. The incubation period for gray francolins is 18 to 19 days. A photograph of francolin eggs is reproduced on page 31.

Brooding and Rearing

Little has been written on the behavior of mother and young once they leave the nest. They are not as shy and much easier to observe than are black francolins. It was not unusual for us to find both parents with a brood. On such occasions, some very young birds were apt at hiding under, or in, anything providing shelter. Others merely squatted, depending on their light sandy color for concealment. Older youngsters preferred escape by running or in flight. Mother and brood were seldom particularly nervous unless pursued, and sometimes could be quite closely approached.

Throughout the rearing period and into the fall, parents and brood usually stay rather closely together though it was unusual for our trappers to net birds less than half-grown, perhaps because of their small size. In fact many fewer young grays than black francolins were commonly caught.



Figure 43. Nest and eggs of gray francolin.

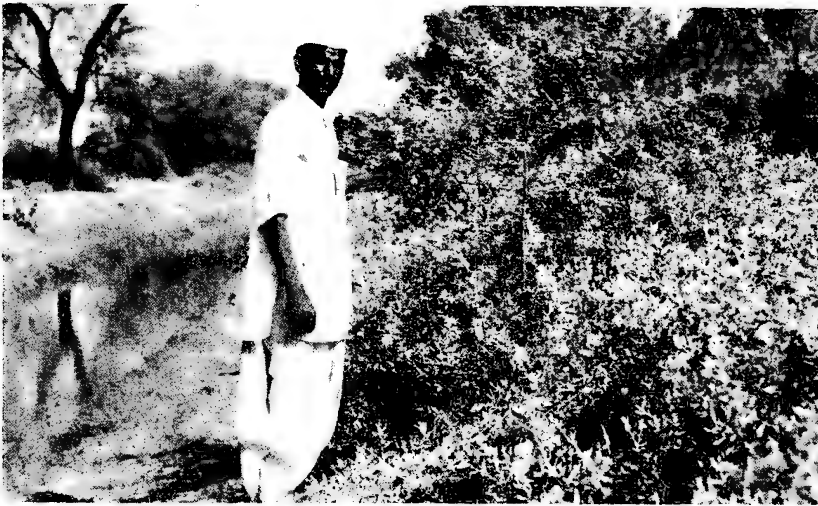


Figure 44. A francolin nested here at the edge of the brush.



Figure 45. The man is pointing to a nest destroyed by irrigation.

The youngsters, when half-grown, resemble adults in actions and coloration except that the black gular line on the throat is less well-developed. In fact in our 9 x 12 x 6 feet holding pens, in which 75 to 80 gray francolins were confined for their two months conditioning period, young birds were as alert, active and adaptable as their mature companions.

Gregariousness

The covey with both parents is the usual social pattern, though Salim Ali (2) observed one brood attended by three adults. Older birds almost always travel in pairs though they may be some distance apart. Larger groups are seen feeding in the same field but usually enter and leave as coveys rather than as flocks when not disturbed. When shot at, coveys fly in all directions, but soon may be heard calling preliminary to reassembling.

Psychology and Behavior

Gray francolins are much more active and independent than are the blacks. They move faster, and are more readily adaptable to changes in habitat. Throughout the breeding season the males are pugnacious, but only among themselves. In the wild, they appear to associate congenially with black francolins, red junglefowl and Indian sandgrouse. In captivity no problems were encountered in keeping grays either alone or with other birds at any season of the year.

To a certain extent these francolins seem to be more intelligent than most game birds. Individuals, when caught, would lie quietly in the hand then suddenly burst out and away. They associated well together in pens, but after a few days would make valiant attempts, too often successful, to dig out under the pens to freedom. Unlike black francolins, half grown grays could be kept in the same pen with adults without being picked on though they were at the bottom of the social order. At any age these birds seemed to adapt very well to captivity. In fact, young birds are often easily tamed to the point where they can be let loose in the house or garden without fear of escape.

Gray francolins are strong diggers, utilizing their bills rather than their feet. In Sind, West Pakistan, we found them commonly digging out corms or rootstalks on which they fed.

Calls

One of the most noteworthy points about this species is its clear, piercing calls. Two variations are common, depending upon mood and intent. When in fighting trim and looking for trouble, it starts with a half dozen or so well-spaced notes sounding not unlike hiccoughs, rising in intensity. These concluded, the bird launches, with great vehemence, into a very loud series of "titur, titur, titur", a dozen or more times repeated, until it is out of breath. When separated from the flock, or

seemingly for variation, it may, after the same preliminary notes, burst forth with a rapid, ringing, "Ke-titur, Ke-titur, Ke-titur" of equally long duration. If the female is near she cooperates with a single, sharp, high note uttered in between the "Ke-titur" notes of the male. Either call of the male may well carry a half-mile on a still day.

Birds call in every season and at all hours, though more frequently mornings and evenings. It is by no means unusual to hear three or more calling sometimes almost simultaneously from different parts of the same scrub. Hume (26) well expressed the feeling of all who know this bird in its native range when he wrote, "Its clear, ringing, inspiring call, once heard, is never forgotten. In upper India these far piercing notes are so inseparably connected with our camp life and all its delights, that, even in the dismal lanes of Calcutta, the cry of a caged bird sends a thrill through one and one seems to breathe again the pure air of the Northwest, heavy with scent of the Mango bloom and to forget for an instant, the squalid surroundings of the fetid metropolis."

Interbreeding

Subspecies certainly cross where their ranges overlap. Yet, even where black and gray francolins share, to a considerable degree, the same habitat, no interbreeding has been reported nor observed. The same apparently is true when these species are kept together in captivity.

Predation

Gray francolins are wide awake, quick-dodging, scurrying birds. As such they would seem to be less subject to losses from winged or ground predators than are black francolins. We found only one mention of loss in the literature. Dharmakumarsinhji (14) reports that not less than a half dozen partridges (gray francolins) were robbed of their young in one summer by jungle crows (Corvus macrorhynchos). Nor were our observations much more productive. Bohl found where one female had been caught on the nest. In a second case, the eggs were destroyed when the farmer irrigated his field and flooded out the nest.

The general situation, as regards predation with both species of francolin, is summed up on page 34.

In many districts one of the most important predators is man. Vast numbers of these birds are shot for sport or netted for sale in the local markets. Yet so adaptable and productive are they, that we did not find a single large district from which these birds have been extirpated by these means though their numbers have been locally very much reduced. One reason for this is that trappers were loath to work more than a dozen miles from their villages, beyond which the francolin were often not much disturbed by the Indian methods of hunting.

Reproductive Capacity

Little, in detail, is known about the reproductive potential of this species. As the most abundant game bird over much of the Indian subcontinent it must be substantial. The facts, so far as is known, are as follows:

Breeding age -- Gray francolins breed the first year following hatching.

Number of eggs -- Normally 6 to 9 in each of 2 or possibly 3 clutches.

Brood survival -- No information other than that it is not uncommon to see 4 to 6 half-grown youngsters with the parents.

Life span -- From 5 to 8 years in captivity; unknown in the wild.

Sex ratio -- Possibly somewhat unbalanced judging from the slightly larger numbers of males over females netted by our trappers.

Renesting -- Probably will renest if the first nest is destroyed.

Second broods -- Very common with some indications that third broods are sometimes raised.

Diseases and Parasites

The diseases and parasites identified from gray francolins parallel rather closely those recognized in black francolins and discussed on pages 35 to 37 of this report. Only one additional disease, ornithosis, was observed in a group of gray francolins, collected from northern India, in 1960. Positive identification was made by pathologists at the U.S.D.A. quarantine station in Hawaii and the birds were subsequently destroyed.

No histomoniasis or blackhead was identified in the gray francolins although the cecal worm, Heterakis, was present in a few wild-trapped birds. Grays were found to be more resistant to fowl pox than blacks, the infection sometimes taking the form of nodules on the legs and feet. Typical lesions about the beak and eyes were also noted in a few cases though the symptoms were much less severe than with black francolins.

No eyeworms were located among gray francolins but the incidence of heartworms (Paranchocerca rousselotti) was much greater than in black francolins, even from the same districts. Of 2,657 grays trapped within 100 miles east to north of Delhi, the microfilaria, indicative of heartworms, were found in the blood of 242 individuals. An interesting difference in occurrence, by sex, was indicated in that 132 or 12.8 percent of the males, and 110 or 7.2 percent of the females examined, were found to be infected. The incidence of this parasite declined spectacularly in 673 grays caught in the much more arid country about Jodhpur and examined by Wayne Bohl. Only 4 individuals or 1.2 percent of the males and 3 females (0.9 percent) were found with microfilaria. Since mosquitoes are a common vector for this parasite some difference is not entirely unexpected. Birds found to be infected with heartworms were, of course, eliminated from our pens.

Analysis of Competing Interests

Relation to Agriculture

Very little interference with agricultural crops has been reported, or observed by us, in studying this species. Scattered instances have been noted where seed wheat, freshly planted, has been dug up. Infrequently, sprouted grain has been pulled up but only where the wheat has been broadcast and then covered by the use of a light board drag. Cultivation in India is often very casual with the seed planted almost at the surface. Thus, this picking up of wheat seems to be largely an extension of their search for waste grain after the fields have been cut. Standing crops, to our knowledge, are not bothered though I would expect them to be tempted by juicy fruits like tomatoes. The small desert melon (citrullus colocynthis), common in waste, semi-arid areas, is occasionally picked open. Cursory food analysis of 60 gray francolins by Husain and Bhalla (27) led to the conclusion that these birds were of considerable benefit to agriculture.

Usefulness

As a source of food -- The flesh of the gray francolin is white, rather dry and not too gamey in flavor. In general, it is not considered to be quite the equal of the black francolin, but the grays are so generally abundant and easy to net that, for many years, they have been sold in vast numbers in town and village bazaars. This traffic is now nominally illegal, but our head trapper reported that large numbers of francolins, mostly grays are still sold in Delhi throughout many a week from October to April. Wayne Bohl contacted one trapper near Jhansi who had 400 grays killed, cleaned, plucked and iced, ready for shipment to market. Leading restaurants in many cities make a specialty of serving "tandouri partridges" and fried francolin are considered delicacies, on many a village menu. We found them to be extremely palatable.

In British times, in India, francolins commonly sold for 4 to 12 annas (5 to 16 cents) each. But inflation has upped bird, as well as other prices so that about Delhi in 1962 one paid from 1 to 1½ rupees (21 to 32 cents) per bird bought in the bazaars. There are still many bird catchers, belonging to trapper castes, who support large families on the proceeds from their netting activities.

As a fighting bird -- It is in southern Iran and the Indian sub-continent that gray francolins come into their own as birds used for fighting. Like the chukar, they are pugnacious, though easily tamed, and commonly kept in small, domed, cages from which they can be released at will without fear of escape. In Karachi it was normal to see a trainer carrying a cage and conditioning his bird by a three mile walk every day. Fridays (the Moslem sabbath) and holidays are the favorites for fighting these birds. Cock fights or mains are largely attended, such fights usually attracting several thousand people in Karachi.

Each male is accompanied by a female in a separate cage. Set on the sidelines, each female, in the excitement of combat, is said to encourage her male to his best efforts by frequent, ringing calls. It was not unusual for several thousand ruppees to be laid on the outcome of a single main. Unlike fighting cocks, metal spurs are seldom used, but the birds' own spurs are often filed down to a fine point. Some birds fight to the death, others give up and shy away from pure exhaustion.

Fighting birds are kept in condition with a diet of termites, uncooked wheat flour mixed with boiled butter, called "ghee", millet soaked in milk, crushed almonds, peanuts, green food, and a very little water.

As a decoy for hunting and trapping -- Gray francolins are less commonly snared by using live decoys than are blacks though the pugnacious nature of the former make them relatively easy to catch by this method. Hume (26) describes the procedure in the following words:

"In early morning or late afternoon, a tame bird is set down in its cage in a small opening in the jungle. To this cage, and also spread on the ground, are attached several fine horsehair snares. By whistling through his (the trapper's) teeth or blowing on the bird, it is soon making the jungle ring with its calling. Wild males answer and soon wild birds with heads up, wings down and tails spread emerge from the jungle, do a war dance around the cage and try to get at the bird inside until one of the assailants finds himself fast by the leg. Disturbed by the necessity of releasing the captive, the rest return to the fray after but a few minutes."

As a game bird -- We enjoyed many marvelous days afield in quest of these francolins. It was rather surprising to find that several of our friends in Pakistan considered these francolins to be poor shooting unless driven because many birds ran from shrub to shrub clump ahead of the hunter. Some usually squat and hide, however, providing good, close shots.

Hume (26) quotes Captain Butler as saying, "The most successful way of shooting gray partridges is to take a dog with you; any dog that will hunt will do. The birds then, instead of running, fly up into the nearest tree from whence they can be easily dislodged and shot."

In the Indian subcontinent far more gray francolins than all the other game birds put together are shot. We have found these birds to be fast, sporty shooting whether driven before beaters or put up individually by walking. They can also maintain their numbers year after year in the face of heavy hunting pressure. As an experiment Balbir Singh, a District Commissioner, his son and Bump, with eight beaters, hunted the same 300 acres of cultivation and scrub near Gurgoan, India, on four consecutive weekends. The first day we flushed at least 100 birds and shot 24. On the fourth weekend about 20 birds were put up, of which 5 were killed. This was more intensive hunting than is to be expected in most American coverts. Singh reports 136 grays to have been bagged by 6 guns in an equal number of hours hunting in the same district in 1962.

Many authors consider that indiscriminate trapping has taken much too large a toll of these birds. Yet we employed some 50 trappers that netted several thousand birds from the same areas over a period of four years without appreciably diminishing the take per man hour. Certainly heavy hunting or trapping will substantially reduce numbers in any locality but so widespread and abundant is this species in favorable habitat that quick replenishment, through rapid breeding and from adjacent coverts, is the rule.

As a pet -- Throughout India and West Pakistan we were seldom without one or more tame gray francolins about the house. In our experience they make ideal, intelligent pets with the often rare added advantage that they are teachable and can often be trusted not to try to escape when outside their cages. Our "Titur" from Karachi returned with us by air to the States and was then carried some 12,000 miles by car and plane to many southern and southwestern States for demonstration purposes. He behaved perfectly around the conference table, though exhibiting an understandable preference for bald heads as resting places when flushed. He would call, when whistled at, and return to his cage when the door was opened.

Gray francolins are often carried by desert nomads, in wicker cages fastened to the backs of camels, horses or donkeys or clutched in the fist of one of the innumerable small fry that ride while their parents walk. Many shepherds on the desert make it a practice to catch and raise one or more grays often carrying them in small cane cages for months at a time while tending their flocks. Captive birds are reported to breed, sometimes laying up to 25 eggs. The young, when raised, are often liberated to wander about the house and dooryard.

Relationship to Other Game Birds

With regard to the gray francolin, the possibilities of competition with native game species, in the event of a successful introduction of these birds into the United States, is the same as that indicated for black francolin on pages 39 to 41.

Among themselves gray francolins are more aggressive and pugnacious than are blacks but their awareness of territorial boundaries and of sex does not appear to extend to their relationship with other game species. A few, to many, gray francolins are consistently met with in almost all types of black francolin habitats except where precipitation exceeds 50 inches a year and the cover is resultantly dense. In all West Pakistan and India I do not recall a single hunt in predominantly black francolin habitat in which at least a few grays were not brought to bag. In the checkerboard of scrub and cultivation, characteristic of much range of both species, one often cannot predict which bird will be flushed and our trappers were constantly catching both species out of the same field of grain, sugarcane or of tamarisk or other brush adjacent to them. In these situations, as elsewhere, there was no indication that the two species were to the slightest degree incompatible. The same seems to be the case where francolin and red junglefowl ranges overlap.

Few gray francolins have been liberated in the States in habitat where native game birds are common. Small populations of bobwhites are present on one gray francolin release area in central Texas. Some Gambel's quail and scaled quail are found in or at the edge of some of the release areas in southern New Mexico. Francolin liberations have been made at the edge of or beyond the range of Gambel's quail in Nevada. There are no native game birds on the island of Lanai in Hawaii where gray francolins are reported to have successfully established themselves (11). Limited to intensive, follow-up studies of francolins released on the areas mentioned above have not indicated any noticeable competition between grays and native game birds.

Little difficulty was encountered in India in keeping up to 85 wild-trapped gray francolins together in 9 x 12 x 6 foot pens for the two months of conditioning and quarantine preceding their shipment to the States. In Karachi, however, one male, subsequently identified as a bird trained for fighting, did kill six other males before being apprehended and removed from the pen. On several occasions, black francolins, gray francolins, chukars, seese partridges, pheasants and red junglefowls were kept in the same pen through the spring and summer months with no sign of combativeness except on the part of the male junglefowl (Figure 22, page 40). In one case in which gray francolins were penned with seesees the latter proved to be the dominant species.

Breeding and Raising

Gray francolins are not difficult to breed and raise in numbers in captivity. In general, the techniques and problems follow closely those discussed for black francolins on pages 41 to 44 of this report.

Several private aviculturists have raised this species quite successfully but to date, the largest number of birds produced in captivity has been on the Texas State Quail Farm near Tyler. Starting with a few individuals of the northern gray francolin, wild-trapped in the lower Indus Valley of West Pakistan, they experienced the usual lack of egg production until the breeders became adjusted to captivity. But as first and then second generation breeders became available, the number of eggs per female increased. In 1963, 60 females averaged 37 eggs per bird. From the resulting chicks 778 birds were reared for trial release (11).

Gray francolins, like bamboo partridges, may, on occasion, nest and rear broods in the breeding pens in which they are confined. Two females, penned at the New Mexico State Game Farm, nested and reared a total of 12 young in 1963. Superintendent Newton believes that, had not most eggs been gathered daily from the pens for artificial incubation, more breeders might have brought up broods (53).



Figure 46. Our pet gray took a casual interest in our work.

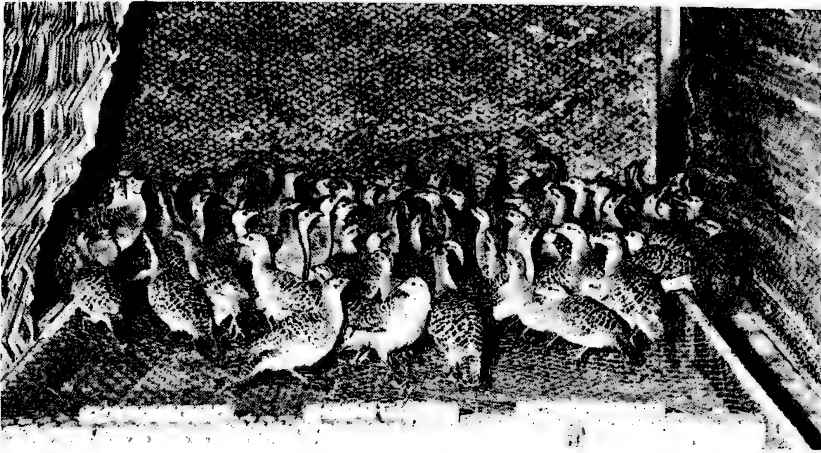


Figure 47. Large numbers of birds were often penned together.



Figure 48. The gray francolin is very adaptable in captivity.

Trapping and Banding

More gray francolins are snared or netted in Southern Asia than any other game bird save possibly the migratory quail (Coturnix). The usual methods employed are the same as those described for black francolins in India and Pakistan on page 44 to 45 of this report. One additional, equally primitive and effective device, was the use of bird lime smeared on the branches utilized for roosting.

In semi-arid Rajasthan, trappers employed by Christensen, often spread their net on one side of and partly over a clump of brush then slowly herded a family covey of nearby gray francolins from one clump of shrubs, across open spaces, into another clump and eventually into the net. From the same region comes a report of using ponies or dogs to flush these francolins 2 to 4 times, after which they take cover and may be picked up by hand from the spot in which they are hiding.

Netting and trapping are now illegal throughout most of India and West Pakistan but the enforcement of applicable laws poses substantial problems which will probably only be solved with the passing on of those who make their living from braided horsehairs and cotton twine. This is one bird that I feel certain will outlast them.

Size 4 leg bands are suitable for use in banding adult gray francolins.



Figure 49. Good hunting!

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